THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 33. Thursday, March 11, 1926. No. 499.

PUBLISHED WEEKLY.

Subscription Terms: 15s per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of
THE FOUNDRY TRADE JOURNAL,
BESSEMER HOUSE, 5, DUKE STREET, ADELPHI,
LONDON, W.C.2.

Telephone: 6611 Gerrard (2 lines).
Telegrams: Zacatecas, Westrand, London.

Contents.

	PAGE
The Tin Position	183
Use of Oil Sand Cores Extending	184
The Bosshardt Open-Hearth Furnace in Foundry Practice	185
The "Merco" Valve	186
The Die-Casting of Aluminium Alloys: A Review of Current Methods	187
Institute of British Foundrymen	184, 191
The Making of the Old Standard Bushel	192
The Foundry Trades' Equipment and Supplies Association, Limited	193
Special Cast Irons	194
Discussion on Mr. Young's Paper on Perlit Iron	195
The Cupola Furnace	199
Correspondence	200
Trade Talk	202
Iron and Steel Markets	204

Forthcoming Events.

MARCH 15.

Royal Society of Arts:—Meeting in London. Cantor Lecture, "Thermometry, I," by Mr. W. F. Higgins.

Sheffield Society of Engineers and Metallurgists:—Ordinary meeting at Sheffield. "Iron and Steel Manufacture in India," Paper by R. Mather.

MARCH 16.

Institute of Metals (Sheffield Local Section):—Ordinary meeting at Sheffield. "Aluminium: Where and How it is Made," Paper by G. B. Brook, F.I.C.

MARCH 18.

Institute of Metals (London Local Section):—Ordinary meeting in London. "The Preparation and Structure of Wires of Pure Tungsten," Paper by C. J. Smithells, M.C., D.Sc.

Institute of British Foundrymen.

MARCH 13.

Newcastle-on-Tyne Branch:—Ordinary meeting at Newcastle. "How to Make a Double Crown Cylinder without the use of a Chaplet," Paper by Jas. Smith.

MARCH 19.

Sheffield Branch:—Ordinary meeting at Sheffield. "Improving Cast Iron," Paper by J. R. Hyde.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.
PRESIDENT, 1925-26: John Cameron, Kirkintilloch, near Glasgow.

LIST OF SECRETARIES—

General Secretary: W. G. Hollinworth, 38, Victoria Street, London, S.W.1.
Lancashire: T. Makemson, 21, Beresford Road, Gorse Hill, Stretford, Manchester.
Birmingham: H. James Roe, 33, Herbert Road, Bearwood, Birmingham.
Sheffield: R. Village, "Bircholme," Dronfield, near Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.
Newcastle-on-Tyne: Colin Gresty, 93, Queen's Road, Monkseaton, Northumberland.
East Midlands: H. Bunting, 17, Marcus Street, Derby.
West Riding of Yorkshire Branch: S. W. Wise, 183, Moorside Road, Eccleshill, Bradford.
Wales and Monmouth Branch: J. J. McClelland, M.I.Mech.E., Druslyn, Bishops Road, Whitechurch, Glam.

Welsh Engineers' and Founders' Association.
Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Foundry Trades Equipment & Supplies Association.
Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

The Tin Position.

With his ordinary metal costs ranging from about seven to seventy times those of the iron-founder, the economical utilisation of his metals is always an item of special interest to the non-ferrous foundryman, and consequently of more than usual importance is the present trend in the tin market. For quite a few years now there has been talk of an approaching "famine" in tin, and after allowing for the usual exaggeration of interested parties, there is but little doubt that the outlook gives cause for some anxiety on the part of all users of the metal.

It is unnecessary to emphasise that two or three times in the last few years the tin market has been engineered to extraordinary heights, and has then suddenly broken in an even more spectacular manner than the preceding rise, as in the spring of 1924, when the market dropped almost £100 within about ten weeks, whilst the boom market that many anticipated for last spring, with suggestions of prices at about £400 a ton, fizzled out with many of the other anticipations for that year. But these movements are inseparable from commodities that easily lend themselves to speculation, and the wise consumer is not lulled into any sense of security thereby, neither is he deceived into thinking that it is all a matter of market operations. He recognises that underlying all these exceptional movements there has been a definite appreciation of prices from an average of about £200 in 1923 to about £260 last year, whilst even under the comparatively quiet conditions of the market at present, the price of tin is gradually approaching £300, although punctuated by many set-backs as the bears get the upper hand.

Of course, in the last few years of the war and the period immediately following, the movements in tin were even more considerable, the market reaching nearly £425 just before the great slump in 1920; but the conditions then existing must be regarded as abnormal, whilst in any case the degree of monetary inflation at that time meant that a price of £425 was really lower than is the price level now existing. Over the latter part of 1923, and throughout 1924, the rise in this metal, though subject to much speculative activity, was kept in check by the large stocks which had been financed to relieve the market in 1920. About this time the market was in a most interesting condition. The demand for the metal had for some time been gradually outstripping the supply, as between 1923 and 1924 the total visible supply decreased by 5,151 tons to 23,160 tons, so that only about 5,000 tons were available at the close of 1924 to meet any further growth in the demand. At the same time it must be remembered that the Eastern supplies pooled under the Bandoeng agreement, amounting to 10,000 tons, were absorbed by the trade, and but for this there would have been a decrease in the visible supply of about 15,000 tons. With these stocks disposed of, it seemed that 1925 would see a market no longer subject to any check; but comparatively little resulted, for the Government's financial measures incurred a general restraint of trade development. Meanwhile, there had been some slight increase in output, and although the delay seems to have removed the probability, which at one time existed, of an immediate run-away market, the outlook for the future remains sufficiently serious, seeing that for the last two years apparent consumption has exceeded apparent production by about 500 tons a month, whilst in 1923 it was even higher than this, with the result that stocks are being steadily reduced.

Unfortunately for the speculative element, the principal consumer, the tinplate industry, has

itself been in a state of internal dissension and reorganisation, and this, combined with the general financial chaos throughout the world, has decreased the call for tinplates, and consequently the consumption of tin. But this is only a temporary phase, and with the world's canning industry making rapid strides and other users of tinplates also experiencing greater activity, together with the extension of the tinplate industry itself in various parts of the world, the question arises as to what the position will be in the near future. As production cannot be materially increased, although feverish efforts are being made to discover fresh sources of supply, it seems that at the present rate of consumption any sudden and substantially increased demand for the metal would undoubtedly produce famine conditions.

These facts are again being appreciated by the outside world, and even though the recent experiences of speculators in the metal have not always been favourable, this will not prevent the confirmed gambler from entering the market again. The trade buyer of tin, however, must seriously ask himself when this movement is going to stop, and how far he can use substitutes for this metal. It would, of course, be an exaggeration to presume that the price will increase indefinitely, even allowing for reactions which may intervene. As the general permanent level advances, so other and older producing areas can be brought into action, such as Cornwall, where tin-mining has largely been abandoned. This may be necessary, in fact, for evidence suggests that within the next few years Malayan production—which is now by far the most important factor in the tin market—will pass its zenith, and thereafter fall off with the working out of the deposits. As against this, however, it appears that Siam holds promise of being as important a tin-producing centre as Malaya has been, if not more so. Moreover, increasing attention is being given to the treatment of scrap, but unfortunately there are no hidden reserves, even though the detinning process becomes more universally adopted.

As to the question of substitutes, this is no easy one. Although the non-ferrous founder is only directly interested in tin as far as its use in the bronzes and white bearing metals are concerned, from the point of view of tin consumption, these are not two of the uses of the greatest importance. It is in tinplate, printing metals, and solders where substitutes would be the most effective; but except in such developments as that of cadmium solder, we believe that practically nothing has been done in the development of possible substitutes along these major lines, although, of course, china, glass, and even wood pulp, offer themselves as substitutes for tinplate in certain food-packing uses. As to the direct lines with which the non-ferrous foundryman is concerned, a rising market in tin will no doubt force many foundrymen to give attention to nickel bronzes and other "special" bronzes. In spite of the considerable amount that has been written about these there is a great reluctance on the part of the average founder to give them a trial. This is perhaps only natural. Some form of economic pressure is generally necessary before people turn to new methods, and it is not denied that the "special" bronzes offer certain difficulties in their successful founding. With respect to bearing metals, most probably, if the need drives, attention will be turned more to the special bearing metals of the lead-calcium type which were largely developed in Germany during the war, when that country suffered considerably from a shortage of tin.

Mr. G. G. Onions, trading as W. J. Onions, 3, New Street, Birmingham, metal broker, has been adjudged bankrupt.

Mr. H. J. Young, F.I.C., has resigned his position as chief chemist to the North Eastern Marine Engineering Company, Limited, Wallsend-on-Tyne and Sunderland, and has opened an office at 3, Central Buildings, Westminster, London, S.W.1, where he will practise as a consulting metallurgist and works chemist. We understand that Mr. Young has been retained by the North Eastern Marine Engineering Company and also by the British Perlit Iron Company, Limited.

Institute of British Foundrymen.

LANCASHIRE BRANCH (JUNIOR SECTION).

The annual social gathering in connection with the Junior Section of the Lancashire Branch was held on Saturday, February 27, at Winn's Café, Corporation Street, Manchester, Mr. R. Stubbs presiding. There was a good attendance of members of the Junior Section, and some members of the Branch itself were present. In a brief address Mr. Stubbs urged the members to maintain their interest and enthusiasm in connection with the work of the section, and thus enable it to fulfil the purpose for which it had been established. At the same time the social side should not be neglected, and it was a pleasant thing to come together on occasions such as this.

An excellent programme was gone through, the artistes including some of the Junior Section members. The list comprised, Mr. Ken Mackay, Mr. Osmond, Mr. Wilde, Mr. Mead, Mr. Ward, Mr. Dummellow, accompanist. A humorous sketch by Mr. Makemson and Mr. Bean was much appreciated. A vote of thanks to the artistes was proposed by Mr. R. A. Miles, who said it was gratifying to discover among the young people who were entering the foundry industry, capacity and talent which could be applied in other directions and make their relations with one another more agreeable. The social side was not without importance; it had some bearing on the successful carrying out of one's regular work.

The vote of thanks was seconded by Mr. Makemson, and carried enthusiastically. A vote of thanks to the Chairman was proposed by Mr. Yeoman, seconded by Mr. Ward, and also carried unanimously.

Use of Oil Sand Cores Extending.

The wonderful strides which are being made by oil-sand cores in foundry practice is shown by the rapid growth of one of the principal suppliers.

Since the inception of the Fordath Engineering Company, Limited, in 1920, it has been found necessary, in order to cope with the present demand for "Glyso" core-oil compounds, to increase the machinery so as to turn out 40 times the amount which was possible at the commencement.

The area of buildings acquired or purchased, apart from the original building, has brought the total space to 20 times what it was in 1920.

To-day, it is found that with these enormous increases, it is only just possible to cope with the ever increasing trade at home and abroad.

The Fordath Engineering Company, Limited, were the pioneers of core-oil compounds, producing a "green" bond.

Progress in Plastic Refractories.

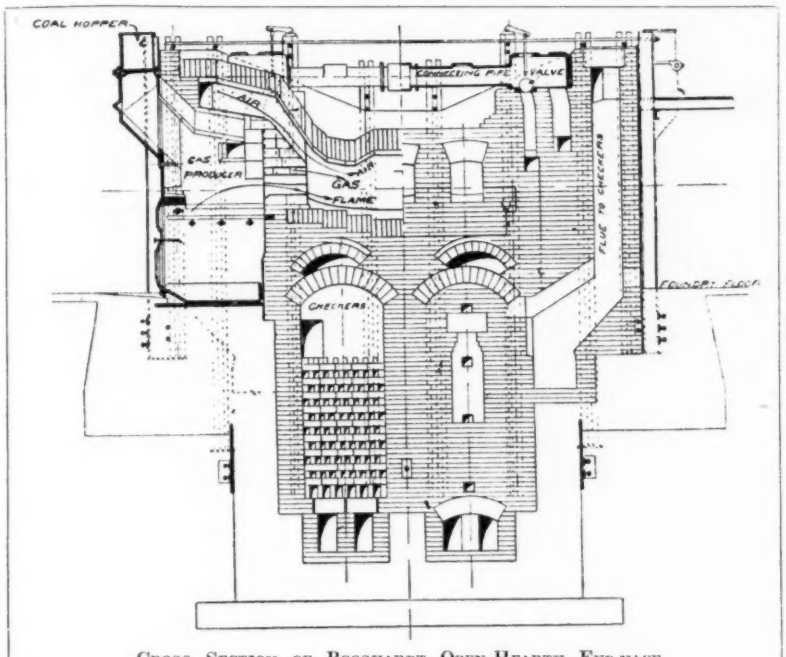
The Burmese State Railway have specified "Silacene" as the lining for their new large cupola about to be installed, no firebricks of any kind being used. There are now well over 100 cupolas completely lined with this material.

A large malleable castings concern has recently experimented with "Silacene," and the exploiters, Messrs. Thomas E. Gray and Company, Limited, of 119, High Holborn, London, W.C.1, have received instructions to ram up experimental side walls for their air furnaces and if these prove a success it is proposed to form the arches of these furnaces entirely of "Silacene."

At the Ipswich Police Court, on Thursday of last week, Mr. Robinson was fined £50 and £50 costs for corruption. The case related to the sending in an envelope a sum of money to Mr. G. F. Cockram, a foundry foreman in the employ of Ransomes, Sims & Jefferies, Limited.

The Bosshardt Open-Hearth Furnace in Foundry Practice.

The first installation in the United States of a new type of open-hearth furnace invented by Edward Bosshardt, a Swiss engineer, is recorded.* It is in operation at the Beloit, Wis., plant of the Wanner Malleable Castings Company, and may be described simply as an open-hearth unit burning producer gas, evolved alternately from each end by two gas producers built into and as part of the furnace. A chequer construction of refractory brick is employed to preheat the air entering the melting chamber. Two chequer chambers are employed alternately, absorbing and emitting heat as in common open-hearth practice. The furnace differs from ordinary open-hearth furnaces in many details, but its chief claim to distinction, aside from any metallurgical accomplishments, is the exceptionally high temperatures obtained in the bath. The furnace was installed by the American Bosshardt Furnace Corporation, New York, under a guarantee to raise the temperature of molten steel to 1,980 deg. Cent. if desired. In every-day operation at the Beloit plant the range of temperature of the molten metal is between 1,915 and 2,090 deg. Cent.



Cross Section of Bosshardt Open-Hearth Furnace.

The installation comprises two melting furnaces, each of 3 tons capacity, although the cubic capacity of the hearth will permit an overcharge of a half-ton or more. The furnaces with the chimney form a complete unit. The design and capacity of the chimney is important, since natural draft without any fan equipment draws air up through the coal-burning grates. The brick-lined steel chimney is about 150 ft. high and tapered from the bottom to the top. This design is said to assure steady velocity for the ascending hot gases which gradually cool and occupy less space during their upward flight.

Each furnace with its chequer chambers is constructed of bricks held together against lateral stress by steel plates and I-beam buckstays, which in turn are bolted together by tie-rods. Silica bricks are used in the portions of the chequers and parts exposed to high temperatures, while the arched roof is of special shapes laid together without binding mortar and held in place by arch action. The side walls, of silica bricks, are carried slightly below the slag line. The hearth is laid with magnesite brick and covered with burned dolomite.

Two gas producers built into the two sides of each furnace are constructed of steel plates and castings and communicate at the top with a charging hopper holding 100 lbs. of coal which may be dropped upon the grates when the bottom door is opened. These producers are operated alternately. When the coal is dropped on the fire, the bottom draft door is closed and the coal starts to coke, evolving hydrocarbon gases which are carried by a lateral port to cast-iron pipes extending to the opposite side of the furnace. At the other side of the furnace these gases mix with gas from the opposite side and then the mixture enters the melting chamber. During the time one fire has been coking and producing gas the other has been burning briskly, the incandescent coke being supplied with free air through a door beneath the grates.

The hot flame is directed across the melting chamber and close over the hearth, as shown by the lower arrow at the left in the annexed section. Meanwhile the hydrocarbon gas coming from the opposite firebox in the manner mentioned is mixed with the excess rising from the active firing side of the furnace. These hydrocarbon gases from the gas producers are driven into the furnace through ports placed above those admitting the hot flame from the coke fire. This action is shown by the arrow marked "gas" at the left of the figure. Heated air from the chequers shown beneath the furnace at the left is drawn upward through the flue at the extreme left and then downward at an angle of 50 deg. into the melting chamber. This downward rush of hot air immediately ignites the hydrocarbon gases and also depresses the flame down upon the metal bath and with a rolling, swirling motion across the hearth to the opposite side. Here they leave a higher port and enter the outlet downward through the flue to the right-hand chequer and thence to the chimney.

At the end of each twenty-minute period the operation is reversed. As the left firing chamber has been considered active in the preceding description, this reversal is accomplished as follows: The bottom draft door below the firing grate at the left is closed, and that at the right

* Mr. Dan M. Avey in the "Iron Trade Review."

is opened. The valve admitting the hydrocarbon gases into the melting chamber at the left side is opened and the one at the other end closed, permitting the gas to enter the cast-iron transverse pipe and to travel across to the opposite side. The flue valve between the left chequer chamber and the stack is opened and that at the right is closed by a partial turn of the wheel. The burning gases and hot blast then travel across the hearth from right to left.

Immunity of the roof from the extremely high temperatures encountered is due to the method of admitting the air from the chequers and also to the roof construction. The roof is built with a flat transverse arch with a dip at either side similar to that encountered adjacent to the flue in a camel-back type of air furnace. The entering air is directed downward, so that a blanket of air is formed over the flame holding the high-temperature gases down against the metal and affording insulation between them and the roof. The roof, about 12 in. thick, is laid without cementing the joints and a measure of protection is afforded by the action of radiation and convection. Standing on a runway laid across the top of the roof, the travel of the flame across the furnace may be seen plainly, and yet no evidence of overheating the roof brick is observed.

Under a 24-hour schedule a maximum of eight heats a day is possible without crowding, giving a melting period below 2½ hours per heat. A grade of bituminous coal averaging about 13,500 B.T.U. is employed as fuel. This is a free burning, straight mine-run coal employed without screening or sorting. The main requirement of a fuel for this furnace is that it shall coke without welding into a solid mass on the grates. At present the fuel is brought by elevator to a floor on the level with the tops of the furnaces and then wheeled to steel bins at the sides of the 100-lb. feeding hoppers. The fireman fills the hopper and then drops the bottom at the proper time. At present 0.4 lb. of coal is burned for each pound of metal in the ladle. The average melting cost is about $6 to $8 (25s. to 33s.) a ton over the cost of the raw materials.

The ferro-silicon used runs 50 per cent. silicon, and is added to the metal in the ladle. The 80 per cent. ferro-manganese is placed inside the central charging door a few minutes, to become heated before it is charged into the bath about 12 minutes before tapping. About 8 ozs. of aluminium per ton is thrown into the ladle for each ton of metal. A basic pig-iron for the mixtures analyses as follows:—Carbon, 3.95 per cent.; silicon, 0.90; manganese, 1.25; sulphur, 0.048; phosphorus, 0.22 per cent.

An average charge at present is made as follows, although as low as 25 per cent. pig-iron charges have been melted:—

Metal.	lbs.
Pig-iron	1,750
Scrap steel	1,250
Runners and risers	2,000
Ferro-silicon	60
Ferro-manganese	50
Total	5,110

The scrap consists of miscellaneous steel with a preponderance of steel rails. The analyses of these materials are practically as follow:—

	Rails, per cent.	Misc., per cent.
Carbon	0.46	0.25
Silicon	0.09	0.25
Manganese	0.70	0.50
Sulphur	0.06	0.04
Phosphorus	0.04	0.04

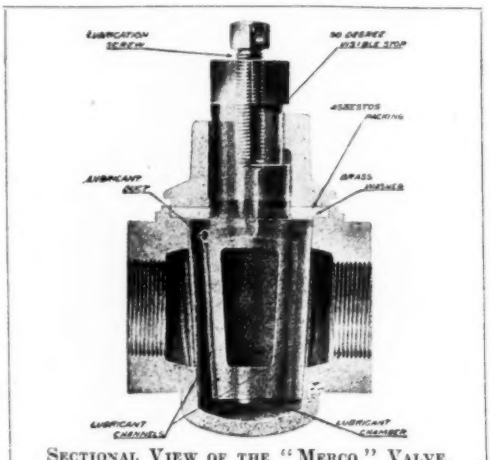
The present product, a low-carbon steel, runs comparatively high in silicon and manganese. The carbon reduction is said to be exceedingly rapid in this type of furnace. When it is necessary to accelerate the decarburisation iron ore is added. When an added carbon content is sought, pieces of carbon electrodes are added to the bath. Heats have been held for several hours merely by adding the required amount of carbon. Apparently no oxidising evils have been encountered under these extreme conditions.

The low-carbon steel produced at present develops a tensile strength in excess of 24 tons per sq. in., with a yield point running exceptionally high. The analyses of two typical heats follow:—

	Per cent.	Per cent.
Carbon	0.16	0.12
Silicon	0.24	0.46
Manganese	0.47	0.60
Phosphorus	0.011	0.019
Sulphur	0.031	0.051

The "Merco" Valve.

The "Merco" plug valve, shown in the accompanying illustration, embodies an entirely new principle of construction, *i.e.*, the combination in a plug cock of lubricant ducts and a lubricant chamber at the base of the plug. The lubricant ducts and the chamber are so located that, when the lubricating screw is screwed down, the plug is lifted from its seat by an infinitesimal amount, in the same way that the plunger of a hydraulic jack is lifted by the water pressure. The plug is then free to turn. Simultaneously with this lifting and turning of the plug, lubricant is distributed from the grooves over the seating surfaces.



Sectional View of the "Merco" Valve.

The lubricant is renewed by the insertion of a cartridge into the lubricant reservoir in the shank of the plug. A check valve is placed at the base of this reservoir to prevent the grease being forced back when inserting fresh cartridges under pressure. Extreme service conditions seldom require more than two lubricant cartridges per month for a valve under constant operation. A visible lug is cast as an integral part of the gland, and fits into a recess in the plug shank, the two serving as a positive stop in opening or closing the cock. This visible stop clearly indicates to the operator the direction in which to move the plug for opening or closing.

Because the bearing surfaces are protected from corrosion by constantly renewed insoluble grease, "Merco" plug valves of semi-steel or cast-iron are now being used in many places where acid-proof alloy valves had been considered necessary. This is particularly true of solutions, which while not strongly corrosive, nevertheless cause pitting and leakage in ordinary valves and plug cocks in a relatively short time. Where the conditions of service are really severe, special alloys are recommended. Lubricants adapted to all kinds of service are prepared in convenient cartridge form. These valves, which have been introduced by The Audley Engineering Company, Limited, Newport, Salop, range in size from 2½ in. upwards.

The advantages of semi-steel were dealt with by Mr. H. Field, of Wolverhampton, in a paper to the Newcastle and District Branch of the Institute of British Foundrymen, in the Neville Hall, Newcastle, on Saturday last, upon "A Further Study of Semi-steel." Mr. M. B. Herbst presided.

The Die-Casting of Aluminium Alloys: A Review of Current Methods.*

By George Mortimer, Member (Birmingham).

Introductory.

From the utility standpoint one of the interesting attributes of the metal aluminium is the ease with which its alloys may be "die-cast." The economic value of die-casting in general is now widely admitted and need not be unduly stressed here. It is so generally recognised that the die-casting of brass and the bronzes have received close and costly attention of late, whilst in America at least one firm is successfully producing iron castings from permanent moulds.

Neither in brass nor in iron, however, is the operation carried out with the facility experienced with any of the B.E.S.A. (British Engineering Standards Association) specifications for aluminium casting alloys, nor do the moulds cost so little or last so long. This fact, coupled with the designers' long experience of these alloys under all sorts of service conditions, has been one of the more active influences in the very striking developments which have taken place in the past decade, in the application of die-castings to engineering and industrial uses.

The development in the use of die-castings in Europe and America has not only been remarkably rapid, but has also inevitably proceeded on lines most suited to the conditions obtaining in different countries. Inevitably, also, a certain confusion arises in regard to the possibilities, technical and economical, of the different systems employed. The present Paper is intended simply to crystallise the ideas of those who are interested in die-castings, yet who are kept too fully occupied in their own legitimate sphere to keep in touch with developments in specialised branches of engineering.

Alloys.

Modern developments have produced a confusing array of light alloys, the possible combinations being practically unlimited. To clear the ground it is only necessary to remember that the present range of physical properties is limited. That range may be obtained, for all practical purposes, as readily from one or other of the well-known B.E.S.A. specifications as it can be by ringing the changes on half a dozen of the more costly of the rarer metals.

The only exceptions of practical note at present lie in the silicon and the silicon-copper alloys, all of which have properties of distinct value to the worker in permanent moulds. Die-casting troubles hinge notably on crystallisation shrinkage and on low physical properties at the freezing range. The silicon alloys, with their low solidification shrinkage and high elongation at high temperatures, stand alone in marked contrast to the more widely-known and adopted alloys; and, as might be anticipated, the silicon-bearing alloys ensure a certain freedom from many of the minor troubles associated with casting in permanent moulds. Aluminium casting alloys to the B.E.S.A. specifications, however, have an advantage in the fact that they are well understood by designers. In the past ten or twenty years their properties have been investigated by different expert authorities. The alloys have been tried out under widely

TABLE I.—*Properties of B.E.S.A. Standard Alloys.*

Specimen No.	Specified chemical composition.	Percentage specified impurities not to be exceeded.					Minimum Tensile properties called for under the specification conditions.*		Average Tensile properties obtained under those conditions.	
		Iron.	Silicon.	Lead.	Zinc.	Tin.	Ultimate Tensile strength. Tons per sq. in.	Elongation. Per cent. on 2 in.	Ultimate Tensile strength. Tons per sq. in.	Elongation. Per cent. on 2 in.
3L11	*Copper* not less than 6 per cent. nor more than 8 per cent. *Tin* may be present up to 1 per cent. *Aluminium* the remainder	0.80	0.70	0.10	0.10	—	Not less than 9	Not less than 3	11 to 13	4 to 6
2L8	*Copper* not less than 11 per cent. nor more than 13 per cent. *Aluminium* the remainder	0.80	0.70	0.10	0.10	—	Not less than 9	Nil	11 to 12	1 to 2
2L5	*Zinc* not less than 12.5 per cent. nor more than 14.5 per cent. *Copper* not less than 2.5 per cent. nor more than 3.0 per cent. *Aluminium* the remainder	0.80	0.70	0.10	—	—	11	3	14 to 16	6 to 10
L24	*Copper* not less than 3.5 per cent. nor more than 4.5 per cent. *Nickel* not less than 1.8 per cent. nor more than 2.3 per cent. *Magnesium* not less than 1.2 per cent. nor more than 1.7 per cent. *Aluminium* the remainder	0.80	0.70	0.10	0.10	0.10	*As Cast** Not less than 11	—	*As Cast.* 11 to 13	1 to 2
							Heat-treated. (No specification yet issued.)		*Heat-treated.* 17 to 22	3 to 6

* (*a*) The *aluminium* used for the above alloys shall be virgin metal. The *copper* shall assay not less than 99.3 per cent. The *nickel* shall assay not less than 99 per cent. The *zinc* shall assay not less than 99.5 per cent.
(*b*) Test-bars 1 in. in diameter and 7 to 9 in. long, cast in iron chills which have been heated before they are filled. The bottom of the chill closed with a sand or clay plug.

* A Paper read before the Spring Meeting of the Institute of Metals. (Slightly abridged.)

varying service conditions, and generally established as reliable engineering materials under the safe chaperonage of all those elusive factors covered by the term "experience."

The properties of the B.E.S.A. standard alloys are given in Table I. Although the following notes deal primarily with these alloys, it may be said that they apply equally to the silicon group or to any light alloy capable of being cast in permanent moulds.

Easily the most popular alloy for general die-casting purposes is the one containing from 7 per cent. to 8 per cent. copper, and known in this country as 3L11. In the United States, under the well-known name of No. 12, this alloy comprises 90 per cent. of the enormous output of aluminium castings for general engineering purposes, whether cast in sand or in dies. A higher copper content gives a hard-wearing machined surface, eminently suited for such parts as automobile pistons. Additional copper also slightly decreases the total shrinkage and the general tendency to porosity—a point of value in connection with castings designed to withstand hydraulic pressures. The indiscriminate addition of copper, however, brings its own penalties in a rapidly increasing brittleness, and in an increase in weight out of proportion to any gain in strength. To guide founders and designers alike in the matter, therefore, there is the specification L8, standardising a content of 12 per cent copper—an alloy which still holds its own in popular esteem for automobile pistons.

The copper alloys have a material advantage over those containing zinc in their relative ability to withstand high temperatures. All zinc-containing alloys are weak at high temperatures, and specification 2L5 should never be used for pistons or for castings called upon to withstand a similar range of working temperature. 2L5 is an alloy, however, which has for twenty years been established as a reliable material in this country, and it is used for crankcases and other stressed parts where Americans would normally use the straight copper alloy. In spite of its weakness at high temperatures, this alloy has been found to give excellent die-castings. The specification figures for tensile and elongation are as often as not considerably exceeded on the standard bar called for by that specification. Those conditions may be imitated with fair accuracy on many designs of casting in a gravity poured permanent mould, and as a result it is possible to obtain from this alloy very strong, reliable castings. The alloy has therefore a useful field in permanent mould work, and the extent to which it is penetrating the erstwhile monopoly of the straight copper alloys indicates that that field is being steadily exploited.

L24, better known as "Y" alloy, can no longer be regarded as a new-comer either as cast or forged. As a die-casting alloy it gives little trouble once its properties are understood, and the castings produced are peculiarly white, clean, and close-grained, giving a beautiful machined surface. "As cast" its properties hardly justify its relative cost, except possibly in the case of pistons, where the excellent frictional and thermal properties of the alloy offer advantages which, taken as a whole, are not yet equalled by those of any other standard light alloy.

L24 is not intended to be used, however, in the "as cast" condition. It is primarily an alloy the properties of which are brought out by subsequent heat-treatment, and the close-grained structure found in a carefully poured permanent mould casting is pre-eminently suited to the conditions governing the consistent success of that heat-treatment. Permanent mould castings in "Y" alloy, intelligently heat-treated, offer the nearest approach yet to Duralumin, and they are being used to a rapidly growing extent in this and other countries, wherever something approaching the strength and fatigue value of a forging is sought and a forging is impracticable.

The Methods Reviewed.

Of the many possible methods of obtaining castings from "permanent" moulds, there are five of interest to the worker in aluminium. They are:—(*a*) Slush casting; (*b*) gravity casting; (*c*) centrifugal casting; (*d*) Cothias casting; and (*e*) pressure casting.

Slush Casting.

This is placed first because it is the simplest of all methods of casting, and dates from remote eras. It dates, in fact, from the first moment that vendors of idols and charms realised that those articles need not be of solid metal, and it is still in wide use in the East for just that reason.

The mould is generally made of cast iron, and is cut to the contour required by the outside surface of the casting. Metal is poured in at the top, the mould is almost immediately inverted, and the greater part of the metal poured out again. That metal which comes in contact with the mould surface has meanwhile set; it does not run out again, and so a hollow casting is obtained at very little trouble and with an excellent external finish.

The field for this system of casting is obviously limited, but many thousands of parts like aluminium kettle spouts, gas chandelier fittings, and similar articles of decorative rather than engineering value, are produced daily by this method here and on the Continent. The moulds cost little, the casting is generally poured by unskilled labour, and requires little subsequent finishing owing to the absence of gates and risers. Most of the current alloys of aluminium are suitable to the process, which is a useful one for getting rid of scrap and skimmings in some running line of fittings, where physical properties are subservient to cheapness, clean appearance, and general utility.

Gravity Casting.

This is a natural development of the above, following on engineering requirements in the direction of a more scientific fixing of sections throughout the casting. In the gravity permanent mould cores are provided as in sand-castings; as in sand practice, also, the metal must set between the walls of mould and core. Therefore, since it freezes first in actual contact with these walls, it follows that there is a period during which there are virtually two castings, one within the other, with the space between them filled with molten metal. That molten metal must be fed as it freezes in turn, which involves gates and risers and all the refinements associated with sand-casting. The problems met with in this method of casting are, in fact, identical with those met in sand-casting, though some of them may be intensified and others the reverse, and though the lines on which these problems are met may appear to differ from accepted sand practice.

That is the first point at which gravity mould casting differs from slush casting. The second is that from the gravity mould one obtains an engineering structure of reasonably accurate dimensions, possessing physical properties reasonably comparable with those obtained from the standard chilled test-bar. The degree of accuracy obtainable hangs on the allowable cost of the die, the skill of the die-maker, the size and intricacy of the casting. Extreme accuracy of the order that deletes all machining is, however, seldom attainable in this form of die-casting. The low weight of the head of metal, the sole pressure used, does not conduce to that consistent, hard definition which makes for scientific accuracy.

Accuracy, however, is here a loosely applied term; this process is so much more accurate than sand-casting, and possesses so many other desirable features, that its field of utility in engineering is a very wide one. It is extensively in use in this country and on the Continent for highly stressed and other engineering parts.

Centrifugal Casting.

The pressure exerted by gravity in the case of so light a metal is almost negligible, and about 90 per cent. of the art of producing clean-cut, sound castings by the gravity mould process lies in considerable care in the design and adjustment of gates, risers, and vents.

Once a gravity mould has been worked into condition, castings may be turned out *ad lib.* by practically unskilled labour, with little subsequent trouble and very little cost per casting. Many of the troubles connected with accuracy, clean finish, the complete running of the more intricate shapes, and so on, are directly associated with this problem of the very low pressure available.

It was natural, therefore, that engineers should early turn their attention to some form of artificial pressure, whereby the mould could be filled by force, and soundness and clean definition seemingly assured.

The simplest form of artificial pressure is that of centrifugal force, and its simplest application is seen in the production of close-grained, cylindrical castings, for machining into piston rings of either cast iron or one of the modern light alloys. The commonly employed apparatus consists of a hollow cylinder mounted horizontally on a spindle. The cylinder has an internal diameter corresponding with the exterior dimensions of the required casting, and the thickness of the latter is set by a flange at either end of the cylindrical mould. Metal is poured in whilst the mould is rotating on its spindle at high speed, and centrifugal force causes it at once to conform to the internal contour of the mould. Excess metal flows out over the flange at the end, and rotation is continued until the metal has set, when a cylindrical casting of peculiarly dense and even grain is removed from the mould.

The application of this form of casting is necessarily very limited, but a variation of the principle is obtained by mounting ordinary gravity moulds at the periphery of a revolving table, and pouring via radial gates from the centre of the table. This procedure has been employed in England with some success in the case of aluminium sand-castings. In die-casting practice, however, time is the essence of the contract, and the time factor is against any great extension of this form of centrifugal casting.

Cothias Casting.

In this system a measured amount of metal is poured into the mould, which is cut to the contour called for by the exterior of the required casting. A plunger having the contour of the interior of the casting, and taking the place of the usual core, is immediately brought down into the mould by a species of power press. The metal is thus forced under considerable pressure to take up a position between mould and core, and to enter the finest corners. The metal sets, the plunger is raised, and the result is a clean-cut casting of dense structure.

This process, as distinct from the previous ones, is true die-casting, in that the metal is positively forced to take the dimensions of an accurately-cut die. The result is a casting having a finish and a degree of accuracy which calls for little or no subsequent machining. Having a parallel with the draw-press of sheet-metal work, however, it combines much of the latter's speed of working with its essentially limited field of utility. The Cothias process produces great numbers of accurate and beautiful castings of relatively open design, but is limited to castings of that type.

Pressure Casting.

Under this heading comes that vast array of patents covering some means of applying external pressure to the metal, and forcing it to pass through gates into the mould. The essential difference here is that no part of the mould moves in order to bring about that pressure. The mould is built up ready with its cores in position, just as in the gravity poured casting, but the pressure due to gravity is enormously assisted by artificial means. It follows that the system is at least as widely applicable as that of the gravity mould, as far as the production of intricate shapes is concerned.

Many of the earlier designs of apparatus incorporated some form of piston or plunger which forced the molten metal through the gates. This principle, developed on varying lines, has always been satisfactory in the case of the heavy zinc- and tin-base alloys. In the case of aluminium it is handicapped by the difficulty of finding a material for the piston, which would withstand the action of molten aluminium under pressure. Metallic plungers were therefore gradually abandoned in favour of one of compressed air, and machines employing this flexible medium are now very widely in use.

In this process air under considerable pressure is brought to bear on the surface of the molten metal at the right moment; the metal is shot into the die and immediately solidified; the cores are withdrawn, the sprues cut, the mould opened and the casting ejected, all by means of cams or pistons operated by compressed air, steam, or hydraulic pressure. The mould and cores are reassembled by the same means, either by the movement of a few simple levers, or more or less automatically; the degree of development is set mainly by economical considerations, the number required from a given mould, the output allowable, the price obtainable for each casting.

On these broad lines pressure casting has been developed very extensively in America, notably by the Doehler and Acme interests, who have brought the art of rapid production of accurate castings to a high standard of excellence. This system again is true die-casting, in that it produces substantially finished castings, in the majority of cases definitely ready for assembly. It is at least as widely applicable as gravity mould work, and it produces castings of markedly more accurate dimensions.

Limits of this system of casting aluminium alloys are tabulated in the data sheets of the Doehler Die-Casting Company as under:—

Maximum Weight for Castings.—5 lbs.

Minimum Limits for Wall Thickness.—$\frac{1}{16}$ in. for small castings, $\frac{1}{8}$ in. for large castings.

Variations from Drawing Dimensions.—0.0025 in. per in. of diameter or length.

Maximum Number of Threads.—External threads 20 per in., cast oversize 0.01 in. to be chased to size. Internal threads not cast.

Holes.—0.093 in. minimum, and not deeper than 1 in. Smaller holes can be spotted to facilitate drilling.

Draft.—Cores 0.015 in. per in. of length and diameter. Side walls, 0.005 in.

Cores less than $\frac{1}{4}$ in. diameter to have 0.005 in. per in. of length and diameter.

Design Features.—Sections of castings should be as uniform in thickness as possible. Large fillets and thin sections are most desirable within above limits. Undercuts in castings should be avoided wherever possible.

Question of Accuracy.

The above limits are quoted from the recommendations of a firm mainly responsible for bringing the art of die-casting in aluminium to its present high standard of development. So much is written on the extreme accuracy of die-castings, and so very much of that is exaggerated, that a word of warning on this will not be out of place.

It is quite true that many millions of aluminium die-castings are produced having a degree of accuracy quite unobtainable on sand-castings, and entirely adequate for the job in hand without any machining whatever. From the above, however, it will be quite clear that the time is not yet when parts like the crankcases of aeroplane engines or the breech-blocks of naval guns can be cast dead to gauge, with all holes, screw threads, oil-ways, etc., ready for assembly. There is one obstacle to absolute accuracy which is not very widely appreciated, and that is the contraction which takes place in the casting after it is taken from the mould—a contraction which may be calculated to a nicety in the case of a solid straight test-bar, but which tends to vary throughout the different sections of an intricate casting. This factor gives rise to minor distortions in the casting on cooling—distortions which are difficult either to foresee or to counteract, and which are unaffected by the most accurate work put in on the die.

The casting in of screw threads is yet another point. Most customers tend to press for this feature, without considering that the removal of a threaded core may double or treble the time of production of any one casting, and introduce all sorts of complications in a casting which should be removable in a few seconds. The cost of this is almost invariably more than that of a rapid tapping operation in a hole already cast to tapping size; and the extra cost inevitably comes on the customer.

Die-casting in any of its approved forms can be guaranteed to save a great deal of costly machining and finishing, and in a great number of applications it cuts out all operations other than mere assembly. The process has its limitations, however, just like any other. It can never entirely

supplant sand-casting in general engineering, nor can it yet attain the precision of a machined part on any but relatively small and simple parts. A due recognition of these present limitations will assist to an intelligent development of the undoubted economical potentialities of die-casting generally.

Choice of a System.

Now, of the five classic methods briefly reviewed above, three may be rejected. Slush casting is not an engineering process, though a useful and economical string to one's bow in the case of decorative parts. Centrifugal casting is supreme in its distinct field, but this is necessarily a limited one. The Cothias process, economical and accurate enough, is confined by its very nature to castings of relatively open shape.

There remain the gravity and the pressure systems, and the choice between one or the other depends on a variety of factors, which may conveniently be considered under the broad headings of technical and economical aspects.

Technical Considerations.

It seems on the face of it that the pressure casting must logically be the sounder—that since an ordinary gravity-poured casting is stronger than a sand-casting, one poured under pressure must necessarily be stronger than either. This is a point of view so often encountered by the author, and so fundamentally wrong, that a brief consideration of the factors which make for soundness in a casting may be justified. For the fact is that a gravity-poured casting is superior from the point of view of metallurgical structure than one produced by the pressure machine, and reasons for this are not far to seek. They hinge for the most part on the total shrinkage of the metal and its propensity to absorb gases.

Firstly, take total shrinkage. In both gravity and pressure casting it is possible to withdraw cores immediately the metal sets, and so allow the casting to contract. In neither case is it possible to withdraw cores before the metal freezes, so that in any case the crystallisation shrinkage has taken place before cores are withdrawn.

Now, in the case of a gravity mould, the relative temperatures of metal and mould, the rate and the direction of pouring, may be so regulated that the casting freezes more or less progressively as the mould slowly fills. Each layer as it freezes can be automatically fed by the fluid layer above, and this factor can do much to counteract any evil effect of crystallisation shrinkage on the strength of the subsequent casting. Contrast this freedom of pouring, these elastic conditions, with the case where the metal is shot into the mould and instantly solidified whilst still in a turbulent condition. As in the case of the gravity mould, the metal in contact with the walls of the mould freezes first, but here there is little to feed the space between what are virtually two thin castings, one within the other. Metallurgically the space between sets to an open, porous structure within a beautifully finished exterior, an analogy for which may be found in the finely built exteriors of the piers of St. Paul's, which on examination disclose a core of indifferent strength.

Similarly in regard to gas occlusion. In both gravity and pressure casting practice the tendency is for the metal to absorb rather more gas than would be accepted as good practice in a sand foundry. The pressure system tends if anything to encourage such absorption by reason of the air pressure applied periodically to the surface of the melt.

The air within the mould is taken care of in both instances by the provision of adequate vents. The latitude in gating and pouring offered by the gravity system necessarily implies a more thorough escape of this air as compared with the high velocity entry of the metal under artificial pressure, but this is an aspect which may well be overcome by ingenuity in design of the pressure die.

The most carefully considered venting, however, will not help matters in regard to the gases occluded within the metal itself. These gases tend only to leave the metal as it freezes, and by that time every vent in a pressure die is effectually sealed by a thin but relatively impervious wall of solidified alloy, and so the gases remain within the casting. In the case of a correctly-poured gravity-casting gases have more time to come off progressively at the rising surface; that they do so is indicated by the marked difference in the fracture of such castings as compared with those from pressure machines.

To sum up, gravity castings when gated and poured, with due care in regard to first principles, may be recommended for stressed parts in preference to sand-castings in the same alloy. In the present state of the art it is doubtful whether pressure castings could be so recommended without reserve, and this in spite of the admitted advances made possible by the development of new alloys of lower crystallisation shrinkage, notably of the silicon group.

The question naturally arises as to why, if this is so, pressure castings are turned out at the rate of many millions daily; so much so that the tonnage from one or two large firms in America alone might well equal the tonnage produced by most of the gravity mould founders in England. The reply is that for a vast range of industrial parts academic considerations of strength simply do not count. All that is aimed at is a light, rigid part, of adequate strength for the job in hand and calling for little or no subsequent work. This is just what is offered by the pressure casting; no more, and certainly no less.

Technically speaking, gravity and pressure castings cater for two quite distinct fields in industry, although these fields necessarily overlap to a considerable extent. On stressed work, gravity casting comes into its own, but to many thousands of parts, pressure-casting is pre-eminently suited on the grounds of economy, rapid production, adequate strength, and a degree of consistent accuracy which cannot be maintained in a gravity mould. Where purely academic considerations of strength are subservient to these considerations, there is only one factor which need be considered in the choice between the two systems—that is, the number required regularly from any one mould, and this brings the subject to the question of economy.

(To be continued.)

New Companies.

Arthur Heaton & Company, Limited, Valley Works, Liversedge, Yorks.—Capital £15,000 in 5,000 6 per cent. cumulative preference and 10,000 ordinary shares of £1. Mechanical engineers. Directors: A. D. Heaton and J. O. Lang.

Hughes Bolckow Shipbreaking Company, Limited, Wharf Byth, Northumberland.—Capital £100,000 in £1 shares. Directors: M. L. Bell, B. L. Dorman, C. F. H. Bolckow and A. W. Griffin.

J. Collis & Sons, Limited, 43, Regent's Square, King's Cross, London, W.C.1.—Capital £10,000 in £1 shares. General engineers, etc. Directors: A. Collis (permanent managing director and chairman) and L. A. Collis.

J. Gordon Alison & Company, Limited.—Capital £50,000 in £1 shares (10,000 7 per cent. cumulative preference and 40,000 ordinary). Engineers, shipbuilders, etc. Directors: P. Duff, West Kirby (chairman); J. B. Duff (manager) and N. Duff.

London & Wales Steel Construction Company, Limited.—Capital £19,000 in £1 shares (15,000 8 per cent. non-cumulative, free of tax up to 6s. in the £, preference, and 4,000 ordinary). Directors: E. King, A. S. Medway, and W. K. Jones.

Malone Engine Company, Limited, 19, Ridley Place, Newcastle-upon-Tyne.—Capital £50,000 in £1 shares.

Overhead Runways, Limited, 45B, Billiter Buildings, Billiter Street, London, E.C.—Capital £1,000 in £1 shares. Manufacturers of and dealers in machinery, tools and factory equipment, etc. Directors: W. Winter and P. G. Ashwell.

R. J. Shaw & Company, Limited, 16, East Street, Gateshead, Durham.—Capital £5,000 in £1 shares. Ironfounders. Directors: R. J. Shaw, R. Shaw, R. P. Kerr and U. Shaw.

Ward & Payne, Limited.—Capital £40,000 in £1 shares (20,000 5 per cent. cumulative preference and 20,000 ordinary). Steel manufacturers. Directors: D. Ward, D. L. Ward and S. Ward.

William McGregor Scottish Steel Grit Works, Limited.—Capital £2,000 in £1 shares. J. T. Beardmore, Palace Chambers, Westminster, London, S.W.1, Secretary; T. F. Whitewright, 172, St. Vincent Street, Glasgow, solicitor.

Institute of British Foundrymen.

NEWCASTLE BRANCH.

Members of the Newcastle Branch of the Institute of British Foundrymen, together with members of the North-East Coast Local Section of the Institute of Metals, spent an interesting evening at Armstrong College, Newcastle-on-Tyne, on January 30.

The visitors met in the Engineering Lecture Room, where an address was given by Engr.-Commdr. C. J. Hawkes, R.N., M.Sc., Professor of Engineering.

PROF. HAWKES in his opening remarks referred to the general depression in industry, and said he thought it was a fit time to consider what was to be the future of engineering in this country. The engineers which we trained in the olden days eventually went abroad, and they themselves are turning out engineers who are our competitors. Therefore, we are in a very different position from what we were in 20 or 30 years ago. The people in those days had their problems which they had to deal with, and we nowadays have our problems to deal with.

The question is, is there anything wrong with our education; if so, what is it? The question of education is frequently debated, but, unfortunately, it is generally by people who know nothing about it.

We are all pleased to welcome suggestions or criticisms from people who know something about the matter, but it is rather galling when it comes from those who have never been through the mill and do not know the full requirements.

There did not seem to be any doubt but that, if a man received a really good, sound education, and was otherwise a good all-round man, he should have no difficulty in obtaining a job in normal times.

Nowadays there seemed to be a tendency amongst students to expect knowledge in a sort of potted form, but it must be realised that experience is a matter of time, and is a thing which cannot be speeded up. He (Prof. Hawkes) did not believe in turning out students wholesale from any college. There were perhaps not jobs for all when they were trained, and, also, if a college had too many students it could not do justice to them all.

In all these questions of education there are certain ideals to be maintained. The engineer sometimes has his own ideals, but he has always to take into account the practical side and has got to consider whether or not it would pay to do a certain thing.

The people who criticised students and their knowledge did not always realise that engineering problems had come to stay and were developing every day. They often thought that everything had to be done by theory, but, to meet with anything like success, one must have theory combined with practice.

Every student should have a certain amount of practical training. He should be allowed to finish his education, and then be sent into the works, because he could not work up an imagination about anything without actually seeing it in practice. He should be able to visualise a cylinder or a condenser tube, but if he has no practical knowledge he cannot do that. It is essential that a lad should have some practical knowledge before he comes to college. If he has not this, he either thinks he knows everything or else he feels depressed because of his very little practical knowledge.

The university man is not criticised fairly. It does not follow that because a man has a degree he is a good man—he may possess a great amount of book knowledge, but no common sense. When a man comes through college, the thing he realises most, if he has any sense, is how very little he really does know. If he realises this he will make progress, and the training which he received in college will help him.

Is the association between industry and university sufficiently close? He (the Professor) was of the opinion that it could be better because, after all, they both worked for one end. We are teaching students so that they will be more useful. Would it not be a better thing if industry took more interest in university work? He believed that in America they encouraged research much more than they do in this country, and that they put a tremendous amount of money into this work. Are we doing enough in this country? Do we put our cards on the table and work together to get the best results possible? Research is a very important part in university life, and it is as necessary to the masters as it is to the students.

Drawing is very important in engineering work, and, therefore, in a college students are taught to make free-hand drawings and to understand them. Also it was endeavoured to try to make the students realise that what they are doing may be useful. Many of them do not look upon it in that light, but very often looked upon it as a waste of time, but later on in life they would see that it was not so.

Visit to Engineering Department.

In the materials laboratory the following testing machines were seen in operation:—100-ton Buckton testing machine, 5-ton testing machine, Izod impact tester, Brinell hardness machine, sclerescope, and Avery fatigue tester. In the Internal Combustion Laboratory there was a 50-h.p. Diesel engine coupled to a Heenan & Froude dynamometer; a 10-h.p. four-cylinder Dorman engine, coupled to a swinging-field electrical dynamometer; 1-kw. petrol-electric set (the power generated being absorbed by means of a water resistance); 6-h.p. Tangye gas engine fitted with a rope brake, and a 6-h.p. Hornsby oil engine, also fitted with a rope brake.

Each engine is provided with means for measuring the brake horse-power, the fuel consumption and the heat carried away by the cooling water. The Diesel engine, the Dorman engine and the gas engine are also provided with means for measuring the quantity of induction air used. A recorder is used for determining the CO_2 content in the exhaust gases from the Diesel engine.

The usual instruments are available for determining the calorific values of the fuels used and flash-point and viscosity of oils.

In the Steam Engine Laboratory the visitors inspected a 200-i.h.p. quadruple expansion engine coupled to a water brake. This engine was designed by Professor R. L. Wrighton, and the various parts were presented by 46 engineering firms on the North-East Coast.

The following engines are also in this department.—Ten-i.h.p. horizontal single-cylinder steam engine; Parson's experimental steam turbine and Delaval steam turbine.

There is also a separate condensing plant for supplying air-free steam to the condensers, so that the effect of the presence of air on the vacuum and on the transmission rates can be more easily demonstrated.

In the Boiler House, a cylindrical return-tube boiler and a Babcock & Wilcox boiler supply steam for power purposes. Also there are three Lancashire boilers for supplying steam for heating the College buildings and for running a few small steam engines in the laboratories.

Another department known as "The Cochrane Hydraulic Laboratory" is equipped with a 6-h.p. Pelton wheel, 5-h.p. Thomson turbine, low-fall turbine, 3-stage electrically-driven rotary pump, and one-stage electrically-driven rotary pump; and also a Pulsometer pump.

The water turbines are fitted with rope brakes, and means are provided for measuring the water consumption. The power supplied to the one-stage and three-stage rotary pumps is measured by a transmission dynamometer.

In this laboratory there is also a 50-ton compression and bending machine, capable of accommodating columns 10 ft. in length and reinforced concrete slabs 10 ft. by 4 ft.

A Ricardo variable-compression engine, with all the necessary apparatus for measuring the consumption of fuel, air and water and the i.h.p. and b.h.p. is housed in a room adjoining one of the laboratories.

XUM

The Making of the Old Standard Bushel.

By H. Littlehales.

As examples of English brass work of more than four hundred years ago, the four mighty bushel measures at Winchester, Salisbury, Westminster and Norwich, are well worth examination.

These four measures alone remain of those ordered by Parliament in 1496. All four are very similar and all are made of brass, a metal which in point of use and beauty is little inferior to any. In the crucible, brass has a striking lustre, which, in a less degree, is at times observable in the finished article.

When the bushels ordered by Parliament, glowing in all their brightness, were first delivered to 42 towns, they must have been of truly magnificent appearance, in their size and splendour. To-day, the four examples remaining are fine large vessels, but of a dense black in colour.

Reproductions of at least one of these in silver and other substances, of different sizes, are to be purchased, the smaller ones for use as sugar basins. A large one in silver formed a wedding present to a member of the royal family not long since.

By the act the standard bushel and gallon measures were sent out to 42 towns there "to remain for ever." Alas for the boldness of this statement, for in the very next year it was discovered that, by some dreadful blunder, these measures were all wrong! A new act of 1496 states that "the said new bushels and gallons lately sent forth be not used nor occupied for no measures, but that they be sent again . . . . into the kings receipt . . . . to be broken, and with the stuff and metal of the same bushels and gallons other new bushels and gallons . . . . be made." It will be seen that in their official excitement the authorities, in defiance of grammar, boldly called on the double negative to emphasize their demands.

The Bushel Measures.

To obtain an idea of what these four vessels are like, we may take the excellent description of the one at Salisbury, which is given with an illustration in Alderman Haskins's "Trade Guilds of Salisbury." The Alderman states that the measure is now in the city museum and that it "stands on three legs, is 10 in. high and 19½ in. in dia. Running round the outer surface is the following:—

Henricus. Septimus. dei. gra rex cia. rex.
Hanglie. et. Francie.

Also a Tudor rose crowned a portcullis and a white greyhound, the three badges of Henry VII. It will be noticed that the inscription has been blundered by the caster who inserted a redundant *rex* between Gra and Cia. Under the *gra* is engraved a letter S for *Sarum*, and lower down an anchor, probably the mark of the workman."

To this may be added that the bushel measure has always had two handles set rather high, so that the contents in measuring may at no time be overturned.

Mr. Pepper, the able city librarian of Winchester, has pointed out that at p. 102 of the second volume of the Rolls Series "Materials for the History of Henry VII," under date 1486, December 14, the established manufacturer's name was because of an entry reading: "To William Nele gunfounder for his expenses etc. in making weights and measures for the king."

From the date, it seems very likely that the original bushels were made by Mr. Nele or his firm. Mr. Nele and other metal workers would probably buy their iron, copper, tin, etc., from London dealers. To-day one can obtain almost anything in London (if you have the money) and in medieval London things were very similar. Of the dealers in metal at the end of the fifteenth century, perhaps one of the largest commercial houses was that of Mr. John Laylande, who like Mr. Nele, held also in his business a sort of official position.

Mr. Laylande and other metal dealers would obtain their iron from Ashdown Forest, in Sussex, or from the importer of the little iron pigs from northern Europe, and their lead, tin and copper, would be procured from the mines of Cornwall and Devon.

A Fifteenth Century Foundry.

A foundry of the time of Henry VII would, we may with reason imagine, present much the same appearance as ours do to-day. As now, the loamy floor would only need to be lightly roofed in and the blast furnace for the reduction of the pigs or broken metal be immediately adjoining.

The pattern shop, and that of the fitters, would be at hand; timber for the former probably seasoning in the shop itself. The tools of the workmen would not be set in a grooved rest as ours are to-day before the window, but would be hanging on nails driven into the walls.

If we try to picture the appearance of the workmen of the foundry, we may see them clad in tunics, with close sleeves, hose and caps of different shapes. Of the brilliantly-coloured garments which all classes then wore on Sundays, the work-day butcher's blue alone remains.

The Metal Worker a Well-built Man.

The London City Letter Book K. tells us that in the fifteenth century the London founders' apprentices had to be of good build and form to be admitted as apprentices. It also tells us, amongst other things, that a very little furnace pan was called a "gueser" * and that great precautions were taken in foundries to avoid fire, most of the houses being largely of timber. There is evidence in many medieval documents, that the little Mary of the fifteenth-century foundryman, was not wholly deprived of stimulating liquid refreshment.

The Maker's Mark.

The somewhat timidly inserted anchor which appears under the word "gra" in the Salisbury bushel, and under the apparently partially paralysed animal in the Winchester inscription, is said by Alderman Haskins to be possibly the mark of the workman.

But this mark is not restricted to the bushel of Salisbury, and it is by no means sure that the maker of the Salisbury bushel made that of Winchester, indeed, such is hardly likely to have been the case.

That it is, as the alderman suggests, the mark of one connected with the work, is almost certain: for the anchor placed well away from and distinct from the inscription appears in little more than outline, being altogether less conspicuous than the bold lettering of the inscription.

Now, if one examines the four bushels remaining, remembering that the act specifies that the local authorities were to have copies made after the pattern sent to them, it will be clearly seen that, as was to be expected, they do not conform to one uniform pattern.

It may be supposed that, in the same way as a whisper goes round a circle of a number of people when the last recipient will hear a perceptibly different version to the first, so the copying of the bushel may have been in no way exactly similar.

The Salisbury measure is 19½-in. dia. and has an error in the inscription and an S for Salisbury, whilst the Norwich measure is 18¾-in. dia. and is stamped "Norwich" on each handle. Further, it has no maker's mark.

As a matter of fact, we do not know that any one of these four surviving bushels is the pattern one sent out as the standard. Any one of the four may have been a copy made from the pattern supplied to that particular borough, though certainly the inscription and decorating seem to point to these four vessels as having been the originals sent. The Westminster bushel is apparently considered by the courteous deputy warden of the Standards Department at Westminster, to be the original standard of the King.

Very little is said in the acts of the form of ornament to be set on the new vessels, excepting that each was to bear a "letter H. crowned," the King's initial. But there is no crowned H. on these measures.

The capacity of the bushel is expressed in language, both clear and interesting. The bushel was to contain eight gallons of wheat, every gallon containing eight pounds, and every pound containing twelve ounces, every ounce to contain twelve sterlings and every sterling to be the weight of thirty-two corns of wheat "that grew in the midst of the ear of wheat."

* [One French word for pig-iron is geuse, whilst gueset is a small pig.—Ed.]

The Foundry Trades' Equipment and Supplies Association, Limited.

ANNUAL MEETING.

The first annual meeting of this company was held last Friday at the Connaught Rooms, Great Queen Street, London, W.C.2. It was preceded by a luncheon, over which the president, Col. W. F. Cheesewright, D.S.O., presided. Amongst those present were Mr. A. S. Beech (vice-president), Mr. H. Winterton (vice-president), Mr. K. S. Bridges (hon. secretary), Mr. D. H. Wood, Mr. D. W. Lennox, Mr. W. O'Keefe, Mr. H. G. Sommerfield, Mr. V. C. Faulkner, Mr. F. Barraball, Mr. A. Ryner, Mr. A. C. Turner, Mr. G. C. Castle, Mr. C. H. V. Wilson and Mr. E. J. Penstone.

The notice convening the meeting having been read and the minutes of the first general meeting of the Association having been adopted, the auditors' and the council's report was submitted, and is printed below.

ANNUAL REPORT.

As is well known, the Association had its beginnings during the early months of the year 1925, and it would not be too much to say that it owes its existence to a strong feeling amongst many firms engaged in the foundry equipment and supplies trade that the time had come when those trades should themselves control the frequency, location and other details regarding their periodical exhibitions. Other suggestions had previously been put forward that the interests of these exhibitors might best be linked up with some existing organisation more or less connected with their trade, but many felt that they were strong enough to support their own organisation through which they could express their own independent views on a subject of so much importance to them. Accordingly, the early part of the year was largely taken up with meetings of a more or less formal nature, at which the multitudinous details connected with the legal formation of such an Association were carried out, but immediately on the completion of these the Council turned its attention to the forthcoming exhibition, and from the beginning it has been their most strenuous endeavour to see that the conditions of that undertaking were framed in the best possible interests of exhibitors on whose behalf they are all the time working. It was felt that one of the weaknesses of these exhibitions, from the exhibitors' point of view, is the uncertainty as to the conditions of the various contracts it is necessary for him to enter into, and the great expense to which he is sometimes put in this connection owing to the granting of a monopoly to some particular contractor, and accordingly, wherever possible, arrangements were made with contractors in various departments on strictly competitive terms, and after various estimates had been considered. At the same time it was clearly laid down that, with the exception of certain monopolies upon which the owners of the exhibition building insist for their own protection, exhibitors should be left an entirely free hand to employ whatsoever contractors they may wish. In making arrangements with Messrs. F. W. Bridges & Sons, Limited, the organisers of the exhibition, to extend to them the patronage and support of the Association, the Council agreed with them the rates of space to be charged in various parts of the building, and also accepted their offer of an over-riding commission of 25 per cent. on the net value of space rentals to be receivable by the Association and to be distributed as to the whole or any portion amongst the exhibiting members of the Association by way of rebate off their space rentals. They also agreed with Messrs. Bridges that no charge should be made for admission tickets, which should be obtainable by exhibitors from the organisers in any quantities for distribution to customers, etc., except a nominal figure to cover the actual cost of printing. As regards overseas visitors, the organisers have undertaken to circularise all the leading foundrymen in Europe, either individually or through their organisations, in the various appropriate European languages, extending to them invitations to visit the exhibition and to be present at a banquet to be given at the exhibition on Thursday, June 17, in honour of these overseas visitors.

Another important activity of the Council has been to establish, through the organisers of the exhibition, the closest possible relationship with the Institute of British Foundrymen, whose convention will be held in London at the time of the exhibition. The London Section executive has accepted the organisers' invitation to hold two of their business meetings actually at the Agricultural Hall, and to devote one day officially to the inspection of the exhibition, on which day (Wednesday, June 16) the officers, etc., of the Institute will be entertained to luncheon, and the whole of the delegates to tea, so that it will be seen that no

Dr. BALANCE SHEET at 31st December, 1925. *Cr.*

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
To Sundry Creditors	2 2 0		By Cash:		
,, Income and Expenditure A/c.			At Bank	62 12 9	
Excess of Income over Expenditure ..	68 2 10		In Hand	3 15 1	
					66 7 10
			Sundry Debtors:		
			Subscriptions in Arrear ..	3 3 0	
			Amount due for Monograms	0 14 0	
					3 17 0
	£70 4 10				£70 4 10

INCOME AND EXPENDITURE ACCOUNT for the Year ended 31st December, 1925.

	£ s. d.	£ s. d.		£ s. d.
To Monograms	1 4 3		Dec. 31st, 1925:—	
,, Formation Expenses	28 6 0		By Subscriptions	103 19 0
,, Printing and Stationery ..	9 13 11		,, Entrance Fees	18 18 0
,, Postages	13 8 0			
,, Audit Fee	2 2 0			
	54 14 2			
,, Balance, being excess of Income over Expenditure for the period ..	68 2 10			
	£122 17 0			£122 17 0

Report of the Auditors to the Members.

We have audited the above Balance Sheet, and have obtained all the information and explanations we have required, and in our opinion the Balance Sheet is properly drawn up so as to exhibit a true and correct view of the state of the Company's affairs according to the best of our information and the explanations given us, and as shewn by the books of the Company.

50, CANNON STREET,
LONDON, E.C.4.
February 17, 1926.

CHARLES COMINS & CO.,
Chartered Accountants, } *Auditors.*

stone is being left unturned to ensure a maximum attendance of interested visitors at this exhibition. Another most important feature will be a technical non-commercial exhibit showing the application of science to every stage of foundry practice, and for the organisation of this a very strong committee has been formed, consisting of delegates from this Association, from the Institute, from the British Cast Iron Research Association, from the Non-Ferrous Metals Research Association, together with other individual scientists of high standing, and in this and other directions it is hoped that the most cordial possible relations will be set up and maintained between this Association and all the scientific and commercial organisations covering the industry.

In the matter of membership it is felt that it is no mean record that, in the course of the first few months of its existence, the Association numbers now thirty-three members. Those who supported the body in the beginning were entitled to membership free of entrance fee, but those who joined on and after April 1, 1925, are required to pay an entrance fee of £6 6s., in addition to their annual subscription of £3 3s. The expenses of the Association are at present fortunately not very great, but it is felt desirable to build up, as soon as possible, a small reserve, and it is hoped that members will use their best endeavours with their friends in the trade to induce them to apply for membership. It may be that in the future, after the exhibition, the usefulness of the Association to its members may extend in various directions, but in any case it is felt that nothing but good can come from the opportunity which the Association provides at its various meetings for the exchange of information and opinions amongst all those who seek to make their living, or part of it, from sales to foundrymen.

In conclusion the Council would wish to place on record its sense of gratitude to the proprietors of The Foundry Trade Journal, which has been appointed as official organ to the Association, for the very valuable help of that publication, both during the formation of the Association and steadfastly since, in connection with the various developments of the exhibition, and it is hoped that this liaison may long continue to mutual advantage.

(Signed)
W. F. Cheesewright, President.
K. W. Bridges, Hon. Secretary.
December, 1925.

Mr. Bridges stated that since the auditing of the accounts in last December the Association had granted £50 to the London Convention Committee of the Institute of British Foundrymen, but, on the other hand, the current year's subscriptions had brought the cash balance up to more than one hundred pounds. He pointed out that the officers of the Association were elected by the first council meeting to be held after the annual general meeting. They could, however, elect more councillors from that meeting up to a number not exceeding 20.

The councillors who had retired by ballot—Mr. Beech, Mr. Shillitoe and Mr. Brackenbury—were unanimously re-elected.

The vote of thanks to the officers of the Association was heartily accorded, stress being laid on the extremely efficient and economical method by which the affairs of the Association were conducted.

In reply, Col. Cheesewright insisted that the Association was to be congratulated on the capable manner in which Mr. Kenneth Bridges had conducted the affairs of the Association, which, though small, was filling a long-felt want to the rather scattered industry which they served. The Association stood for progress by modern business methods with a complete elimination of anything underhand. High-class concerns had little to lose by a closer association with their competitors.

Mr. R. Hobson, president of the Steel Company of Canada, has died at the age of 65 years.

The Ransome Machinery Company (1920), Limited, of Windsor House, 46, Victoria Street, London, S.W.1, have recently received an order from S. Pearson & Son for six of their concrete mixers, fitted with electric drive, also ten tip-carts for use on a South American contract.

Special Cast Irons.

In a Paper entitled "The Application of Special Cast Irons in the Engineering Industry," presented to the Institution of Engineering Inspection recently, Mr. S. E. Dawson, A.I.C. (foundry manager, Ferranti, Limited), after outlining the constitution of cast iron, discussed at some length the effect and distribution of the constituents, and the testing of cast iron.

The discussion did not, as one would expect with a Society of this type, centre round the testing of cast iron. We print below a short *résumé* of the remarks made.

Colonel Crozier asked what was the difference between having pearlitic iron granular and in a laminated form, because a good deal of stress was being laid upon this point in certain patents which were being taken out.

Mr. S. J. Hawkins asked whether the non-magnetic cast iron could be made malleable, and also how the cost of that iron compared with the cost of ordinary cast iron. He agreed with Mr. Dawson as to the difficulty of arriving at the strength of a casting by taking a test-piece from the top or bottom. His usual practice was to take three test-pieces and get an average.

The Chairman (Mr. R. P. Wilson) asked the author if he could give information with regard to "Permalloy," which he believed was a steel having very little, if any, magnetic properties. With regard to non-magnetic materials, he said that, whereas previously impurities had been separated from ores by attracting the magnetic materials, Mr. W. M. Mordey had utilised the hysteresis effect for the purpose of separating the non-magnetic impurities contained in the ores.

Mr. Dawson, replying to the discussion, said that non-magnetic malleable cast iron could not be produced. Non-magnetic iron, if raised to a temperature above 980 deg. C., had the opportunity of becoming magnetic, and if it remained at 980 deg. C. for three or four days, as in an annealing oven, and were allowed to cool very slowly, the heat brought about a distinct molecular change from austenite to martensite. That, however, did not necessarily spoil it, and one could heat it again to 980 deg. C. and stop the annealing effect by quenching. To anneal non-magnetic iron, it was necessary to quench; otherwise, one would get a magnetic material, which was just over the borderline, and which was martensitic. Quenching brought the material back to its austenitic, soft condition. One could not make non-magnetic malleable cast iron, because the essence of the malleable process was to produce a hard cast iron so as to get no graphite growth of any size, and then to anneal it.

Dealing with the cost of "Nomag," he said it was greater than that of ordinary cast iron, firstly, and almost wholly, because of the increased cost of the ingredients, and to a small extent, perhaps, because it was a monopoly, or was patented, or however one might care to describe it. Ordinary cast iron in small castings cost, on an average, about 3d. per lb., whereas non-magnetic iron would cost an average of 5½d. or 6d. per lb., so that it was about twice as dear as ordinary iron. It was only about half the price of gunmetal, however.

On the question of test bars, he disagreed with Mr. Hawkins' practice of taking the average of three, because he did not think any one of them was right, and the average of three wrongs did not make a right.

With regard to granular and laminar pearlite, he preferred not to say very much about pearlitic iron, because there were two camps taking an active part in the Press on this question, and it was very difficult for him or anybody else to express an opinion, because, whatever he said, he would get his knuckles rapped by one side or the other.

Permalloy, to the best of his knowledge, was a 40 per cent. nickel-iron alloy. It was very expensive, of course, because nickel was a very expensive element. Assuming that nickel cost £175 per ton, 40 per cent. of a ton would cost about £70, which was a great deal when compared with the price of a ton of iron or steel.

Discussion on Mr. Young's Paper on Perlit Iron.*

The BRANCH-PRESIDENT (Mr. G. C. Pierce) said he had had an opportunity of examining Perlit iron, and it was a wonderful material. If all that Mr. Young had said with regard to the future of Perlit iron were true—and he believed it was—he was wondering what would happen to all the foundries in this country to-day. He believed he was right in saying that one of the first necessities when working the Perlit process was a laboratory attached to the works. Many foundries to-day were doing important work, but they had not the ghost of a chance of producing Perlit iron unless they altered their methods. At the same time, he could not imagine that they would all adapt themselves to the working of the Perlit process at once, and he asked Mr. Young to express his views on that aspect of the case, because, if Perlit iron would do all that was claimed for it, the people who wanted perfect castings would go to the foundries which could turn them out, and many of the existing foundries would lose their work if they did not adapt themselves to the new conditions.

MR. YOUNG replied that that question was vitally important, and must be answered by the statement that every modern foundry must have science. It was a question of the survival of the fittest; that was the case in non-ferrous and steel work, and it would come in the case of iron foundry work. On the other hand, he did not think the Branch-President was quite right in saying that every iron foundry would lose its business if it did not adapt itself to the new position, because cast iron, as such, would still find an important market, and there were some things which it would not be necessary to make by the Perlit process. Sash weights provided such an instance. There were many castings in which weight was the principal requirement, and others for unimportant work, which would not be made by the Perlit process, so that there would be plenty of work for the ordinary jobbing foundry. Modern foundries, however, must have science, whether they produced Perlit iron or not. His own foundry had introduced science 15 years ago, though they had not then the Perlit process. It would pay any foundry to put down a small laboratory. If a foundry controlled its pig-irons, for instance, the pig-iron suppliers would realise it. A few days ago he had analysed some pig-iron from one of the biggest suppliers in the country, and had found 4½ per cent. of carbon in it, although their letters and booklets stated that it contained 3⅛ per cent. The pig-iron people could afford to run laboratories, and it was reasonable to ask them the analysis of the consignments they delivered, and he felt certain they would comply with such a request. At present the foundryman accepted anything that was given to him, and he (Mr. Young) did not blame the pig-iron suppliers. For working the Perlit process it was necessary to employ a chemist. That was not a point against it, but in its favour, because the sooner the foundry trade used applied science the better for the industry.

Replying to a question by another speaker as to the number of wasters produced in Diesel work, he said that at the beginning of Perlit the wasters were about 20 per cent., but to-day, on all sizes of their own Diesel castings, they were getting about 5 per cent.

MR. S. E. DAWSON (Lancashire Branch) considered that Mr. Young had been rather hard on the pig-iron suppliers. He (Mr. Dawson) was a founder, and not a pig-iron supplier, but he had found that the suppliers of pig-iron did keep quite close to the analyses required nowadays.

The Value of Test Bars.

With regard to the value of test bars, he asked Mr. Young if a standard diameter test bar did represent a thick section equally as well as it represented a thin section. Most people tried to argue that the ordinary test bar represented the casting, but it could not, unless, of course, the casting were identical in section throughout with the test bar. What it did represent was the quality of metal used, and, so long as it did that, a test bar was of value, so that it would not do to take too seriously a remark by Mr. Young that test bars could not be relied upon in ordinary foundry practice. If one knew that the metal used gave a test figure, on a standard bar cast separately, of 15 tons, one knew that it was a better metal than one giving a test figure of 12 tons, and, after all, foundry practice was largely a matter of experience. In ordinary foundry practice one knew that a test bar breaking at 15 tons was suitable for cylinders, and that the metal in a test bar breaking at 10 tons was suitable for something else. Therefore, it was right to use test bars, but it was not right to say that they represented castings.

An important point in favour of the Perlit process was that it would obviate draws at the corners of castings. That was most valuable, because at the junction of two sections the tendency to draw was far greater than one would expect on comparing the areas or volumes at the junction with the areas or volumes of the sections leading into the junction; the tendency was perhaps ten times as great as one would expect. The tendency to draw was considerable in ordinary castings, and if the Perlit process overcame that it had done something wonderful.

Scrap Percentages.

All founders produced bad castings, but Mr. Young, when speaking of 30 per cent. bad castings, must have been specialising. In one case a friend of his (Mr. Dawson's) had gone to a foundry making motor-car cylinders, and had found that the losses were 70 per cent. Within a month or six weeks he had reduced those losses to 30 per cent., but the foundry concerned was only making the one article. He could mention cases in which the losses in the foundry were only 2 per cent. over a period of at least ten years. There were some castings sent back from the machine shops, however, which represented another 2 per cent. of the output, so that the total losses were 4 per cent. of the output. The castings were examined very critically, and if they did not fit the jig, if there was the slightest tendency towards hardness, or a slight shrinkage, they were scrapped. The organisation in that case was special, just as another organisation producing 30 per cent. of wasters might be specialised. It was not fair to say that ordinary foundry practice produced 30 per cent. wasters, because if it did the prices of castings would not be what they are to-day.

Centrifugal Castings and Soundness.

Referring to Mr. Young's illustrations of fuel valves made in ordinary cast iron, and which, if they were sound in one part, were porous in another, and so on, Mr. Dawson said that centrifugal castings were produced with varying sections which were quite sound throughout, in ordinary cast iron. There was a good deal in the centrifugal process, in that it did produce sound castings, the structure of which was different, of course, from the Perlit structure. It was simply a matter of getting rid of all the gases and dirt.

Graphite in Perlit Iron.

With regard to Mr. Young's remark that the Perlit process produced graphite which was in rather different form from that of the ordinary graphite, he wondered if that had any bearing on the fact that one could take drillings from ordinary cast iron, and particularly malleable cast iron, and could extract the graphite by the ordinary process with hydrochloric acid, and treat the residue in an ordinary oven. By heating even at 200 deg. C. some of the graphite could be removed, say 10 per cent.; by heating to 300 deg. C. another 10 per cent. could be removed; and at 400 or 500 deg. C. another 20 per cent. could be removed, until the whole of the graphite was extracted, showing that there were different degrees or kinds of graphite in malleable and ordinary cast iron. He had wondered whether there was any correlation between that graphite and the graphite in Perlit, or whether *some* of

* See February 11 issue of THE FOUNDRY TRADE JOURNAL.

the graphite in the Perlit structure was different from the ordinary graphite and perhaps helped to give strength to Perlit iron by not forming planes of cleavage between the crystals.

Another point which was of interest was the condition of the carbon, as seen in the photographs. In the Austenitic structure of iron—and, of course, all molten iron was Austenitic—the carbon was the same, as seen through the microscope, as in the Perlit iron. Was there any relation between them? As to a suggestion by Mr. Young that gear wheels were not cast in this country as such, *i.e.*, with the teeth in, Mr. Dawson said he had helped to make hundreds of large diameter gear wheels, and in those cases a chill was not used in order to avoid a bad spot in one place, thereby producing a bad spot in another place, as suggested. The wheels were made in the ordinary way, and he did not remember that there were many wasters.

Practical Details Desired.

Mr. Dawson also asked for more information as to the production of Perlit castings; he did not wish to know the process in all its details, of course, but would like more information as to how the Perlit castings were produced. All those present had a smattering of an idea that it was done by heating the mould before pouring the metal in, and so on, but he at any rate had not gleaned from the lecture how the iron was made. Finally, he said that the lecture had made the foundrymen present feel, perhaps, a little despondent, in that it showed how far behind the times was ordinary cast iron practice as compared with the Perlit process, but there was some consolation in the fact that Perlit iron would not be required for all classes of work. In fact, when one looked into the matter closely, it was apparent that, even though, as they all hoped, there was a very big future for Perlit iron, there would still remain a very big share for ordinary cast iron. It seemed to him that there were just as many cases in which Perlit iron was not required as there were cases in which it was required.

Futility of Test Bars for Cast Iron.

Mr. Young, replying, pointed to Mr. Dawson's remark that, when he had tried to get the pig-iron people to keep to the analysis asked for, they did so; that, he said, showed the benefits of trying to make them. Mr. Dawson had perhaps gone a little astray in his references to test bars; he had tried to put up a case for the test bar, but in his (Mr. Young's) opinion, it was a very weak one. For the purposes of illustration, he took the case of a superheater cylinder liner, which had to wear well. If one put a test bar on that liner, and the liner were made of the best material for superheat work, the test bar would be white, and would give a test of, say, 6 or 7 tons. If a test bar were cut out of the liner, however, it would give about 15 tons. He himself had had a deal of experience of that. The test bar, if it represented anything, represented itself, and it did not tell a founder that the quality of the metal was suitable for the job. For a casting which was required to wear well it was necessary to know the amount of manganese in it; no tensile or transverse test would show the amount of manganese. It was simply a smashing test, and he believed the test bar fiasco had stopped progress in cast-iron practice. So long as a founder got through the tests, he was satisfied, and was tempted to concentrate upon getting past the inspector, and not to worry further. In this connection he mentioned the case of a large turbine casing. The test bars were cast on, and stood up to the test of 11 tons. There were bolt holes drilled round the flange of the casing, and on account of their appearance he asked for a piece of the flange to be broken off. A test bar taken out of it gave a test of 7 tons. He could not see how a test bar weighing, say, 12 lb., could represent a casting weighing 20 tons, or even ¼ ton.

High Scrap Question.

He had never said that the average foundry produced 30 per cent. waster castings. He had merely pointed to certain trades in which there was 30 per cent. of bad castings, and to the inability of the foundrymen and metallurgists concerned to do any better, which proved the difficulties one was up against in connection with cast iron. In work of the ordinary type there was often only about 2 per cent. wasters, but the castings had to be patched up in the machine shop, and showed the limitations of foundry practice. He was not saying, however, that the castings were not good enough. In Perlit work scantlings of many castings could be reduced by 10 per cent. or more; meaning less weight and a metal of a known tensile strength throughout the casting, which the drawing office could calculate upon. At the present moment, with an ordinary casting, one looked it up in Molesworth, added a bit for luck—a rib here and a boss there, according to the various failures that had occurred in past years—until there was produced a great and heavy article which could not fail. All that sort of thing had to be done away with; one must have a reliable material which could be calculated and relied upon; and so reduce thicknesses. Recently he had seen a casting which was 100 years old, and it was almost precisely the same as the average casting to-day, containing high phosphorus, high silicon, and about 0.5 per cent. of manganese. Cast iron had made little progress, and it was time it did. He believed that centrifugal castings were introduced because of the inability of the ordinary foundryman to make a sound casting. He had not been shown any extraordinary quality in centrifugally-cast metal, but the casting itself was good. The fuel valves he had referred to, however, were unsuitable to be made by that process.

Practical Details.

Replying to Mr. Dawson's question as to what the Perlit process was, he said there was no secret about it; it was a patented process. If one visited the foundry and saw the pouring of Perlit moulds, one would not know that anything other than the ordinary process was being carried out. When pre-heated moulds were assembled, the moulds were completed, ready for pouring, namely, dried, assembled, and then put into the core stove and heated to the required temperature, which was about 400-450 deg. C. on the average. When heated to that temperature they were poured, and there was nothing else in it, except, of course, that the metal must be of a composition and temperature to suit the temperature of the mould, whatever it may be in any particular case.

Mr. V. C. Faulkner: The temperature of the mould has to suit the composition of the metal?

Mr. Young replied that that was not necessarily so, and that one could do it by several means. The facility of the process when hot moulds were being used was such that if both heavy and medium castings had to be produced the whole of the moulds could be taken out of the stove together, and the lighter castings poured first, so as to get the higher temperatures.

Mr. Faulkner: Is there control by pyrometers?

Mr. Young replied that there was control by pyrometers for the first month or so, but after that one knew what to do, providing, of course, that the core stove was always controlled. With regard to the temperature of the metal, he said that in different foundries there were different ideas as to what was "hot" metal. Sometimes it could hardly get out of the ladle, and sometimes it was white hot. For Perlit work, however, one must be able, if necessary, to produce the hottest metal that the cupola would give—about 1,450 to 1,475 deg. C. For a very thin casting the mould, if heated, was heated to a higher temperature than the mould for a very heavy casting. For a motor casting the temperature might be nearly 500 deg. C., whereas, in the case of a Diesel cylinder, the temperature might be about 350 or 400 deg., but, of course, the composition of the metal used for a motor cylinder casting was different from that used for a Diesel cylinder casting. If a metal of a certain composition were used at present, it simply meant choosing another composition from the Perlit process, the new composition being controlled just as the present one was controlled.

Graphite In Cast Iron.

With regard to graphite, he said it must not be forgotten that the graphite in cast iron, as seen

in photographs, was not really graphite; it was simply a number of spaces in the metal, these spaces being only partially occupied by graphite. He believed that Perlit iron had lesser voids than ordinary cast iron (though perhaps the amount of graphite was the same), and that the distribution also was different and uniform. Probably it was the size and shape of the cavities that caused the extreme brittleness of cast iron.

Graphite and Voids.

MR. YOUNG added that he had his own theory about Perlit, and he did not think Fletcher, or anyone else, had dealt with the question as to why the metal was homogeneous all through. It was extraordinary that a casting having different sections should have the same structure throughout. He himself believed that when an ordinary cast-iron casting was poured the metal heated up the surface of the mould and formed a shell all round, the metal growing from it, thereby forming a centre. In the Perlit process, however, the sand was heated, and it looked as though the inner surfaces of the mould and the metal touching them all attained the same temperature and the whole thing cooled down as one mass. In one case, that of a cylinder poured in Perlit, the top bar was moved an hour after pouring, and the metal was found to be all molten underneath, but in the same type of casting cast in the ordinary way the bar could be moved about 20 minutes after pouring, and nothing happened. He would prefer not to go into anybody else's theories, or to say that his own were correctly stated.

He did not think there was evidence that there were different kinds of carbon in Perlit and ordinary iron. He believed the difference between the two irons was due to the improved cavities, to the structure, uniformity and to the homogeneous matrix.

MR. DAWSON: You do not suggest that there are cavities throughout iron?

MR. YOUNG: Yes, thousands.

MR. DAWSON: Not to the extent shown on the screen?

MR. YOUNG: What you have seen are cavities, and not graphite.

MR. DAWSON: But according to the eye it is graphite.

MR. YOUNG: If you polish up a section and look at it in a bright light, you will see cavities.

MR. DAWSON: You have probably removed the graphite by polishing.

MR. YOUNG said there was graphite in the cavities, but it did not fill them. Mr. Logan, of Newcastle, dealing with microphotographs of a cast iron containing a known amount of graphite, had made a circle and had plotted out the space which the graphite should have occupied according to the analysis. He had put black paper on to represent the graphite, but the area covered by the paper was not as great as that indicated by the microphotograph. Undoubtedly that seen under the microscope was partially-filled cavities.

With regard to gear wheels, he had not said that we in this country did not cast them in shape. What he had said was that " at the foundries he had been to " the wheels were cast solid, and the teeth machined out afterwards. The point was that the castings were all more or less faulty, and the managers of the works concerned had pointed it out.

MR. DAWSON said he could take Mr. Young to a foundry which turned out good wheels.

MR. YOUNG reiterated that at every works he had visited the metal was porous at the base of the teeth (when cut out). The wheels, however, went into service because, although the metal was porous, the wheels were not sufficiently bad to warrant their rejection. There were about 10 per cent. rejects, but there were few really good castings.

MR. DAWSON asked if he were sure that he went to the right foundries.

MR. YOUNG said they were foundries which specialised in that work. He had also seen gear wheels cast, with the teeth in, by the Perlit process, and the teeth were of the same structure, strength and hardness throughout, and resisted impact.

More Practical Details Wanted.

MR. C. CLEAVER asked Mr. Young whether larger or smaller heads were required for feeding the castings. Again, in the case of a variety of castings, ranging from a thickness of $\frac{1}{8}$ to 2 in.—he did not mean $\frac{1}{8}$- and 2-in. sections in the one casting—he gathered that they would all have to be cast at different mould temperatures, and that the analysis of the metal would have to vary for each particular casting or group of castings. It seemed to him that the cost would be rather high if it were necessary to have different core stoves at various temperatures for different grades of castings. With regard to the control of the metal one must have different charges in the cupola with varying silicon and carbon contents. What happened if at any time there was a rather higher silicon content than had been estimated for, and how was the mould temperature regulated to suit that variation? With regard to Mr. Young's statement that he could use common instead of high-class pig-irons, he asked what he meant by common " pig-iron "—whether it was ordinary No. 3 Northants, or whether it was ordinary cylinder pig-iron, and what the carbon and silicon contents were. Finally, he asked for the relative costs of Perlit and malleable castings, because, for small work, the two seemed to be somewhat parallel from the point of view of utility.

MR. YOUNG said there was evidence that in Perlit work the size of the feeding heads could be reduced considerably. At the same time, he himself preferred large headers for important work, because it was better to be sure of a good casting than to run the risk of using a smaller head. After all, when a head was cut off, it was good known scrap. He had never been able to see that much was to be gained by reducing the size of heads, a practice which might result in the production of bad castings. With regard to variation of mixture, he said that, in his experience, castings varying from $\frac{1}{2}$ to 5 or 6 in. in thickness were made, and there were three mixtures, one light, one medium and one heavy. They had quite as many before using the Perlit process. They did not worry about core stove temperatures. For Perlit in hot moulds all such were heated to about 450 deg. C., and then taken out of the stoves, the lighter castings being poured first, and the moulds for the heavier castings were allowed to stand long enough for them to cool down to, say, about 400 deg. C. The process gave sufficient latitude to allow for the small variation of silicon in the cupola. After all, one was not making Perlit for the National Physical Laboratory every day, any more than one did in other special cast iron, and the Perlit iron producer was for commercial use.

Cost of Working the Process.

When referring to high-class pig-iron, he had had Diesel work in mind. For Diesel work he had used pig-iron made in Sheffield, costing about £9 to £12 per ton during the last three years, but the irons used for that work to-day consisted of pig-irons of Middlesbrough class and steel, which were much cheaper. He had found that in the majority of foundries in this country quite expensive pig-irons were usual when anything like good-class work was turned out. He had never before known where the expensive pig-iron went to. (Laughter.) If those foundries used the Perlit process they would not be using so much of this expensive pig-iron. If they had proper laboratories they would be using still less, because it was possible to work up steel and get as good results as with low-carbon pig-irons. On the other hand, a small man, who had not a laboratory, would be able to buy a suitable pig-iron straight away, and when the Perlit process came into its own the iron people would supply suitable pig-iron. In fact, he knew two suppliers who were willing now. The cost of Perlit would vary according to the class of work done and the organisation in the foundry. For instance, if moulds had to be heated after assembly, it was not the cost of heating that mattered, but the perfection of the organisation; the better it was, the cheaper the process. His firm considered that to-day the hot-mould Perlit castings cost them 10 or 15 per cent. more than the ordinary iron castings, owing to the delay in connection with labour. Malleable was very

XUM

expensive, but Perlit was made straight out of the cupola, and was, therefore, much cheaper in cases where it was an effective substitute.

Mr. Gibbs said that, bearing in mind that pig-irons of exactly the same chemical composition were said to vary in their physical results, it might be that the fixing of the composition of the metal, and the heat treatment, in the Perlit process would not be sufficient to give castings of the desired mechanical qualities. With regard to the statement that with the Perlit process the cooling rate was the same throughout the casting, he said he gathered that in a large number of cases, such as big gear wheels, Mr. Young used a chill in the centre. With regard to the globe valves mentioned, Mr. Young had pointed out that, in the ordinary process, there were sparkling areas in those valves, and he had understood him to say that, with the same composition and made by the heated mould process, the structure would be uniform. He believed that was a mistake.

Mr. Young agreed that that was not likely.

Mr. Gibb continued that it had been emphasised that a low-silicon content was essential, but he asked if it were not possible to use an iron of pearlitic structure without insisting upon a low-silicon content. Was not the total carbon content the most important point? With regard to superheater castings, he said that before the war his firm obtained them from Germany. He had then tried to produce them in cast iron, but had had some failures. He then reduced the total carbon content and heated the moulds, and had continued to do so since. Was he infringing the Perlit patent?

Mr. Young said that among the pig-irons on the market and used in everyday work, he had never met one which did not give physical results in accordance with its chemical composition. Freak irons need not be considered, and if one received such an iron one would throw it out. He disagreed that total carbon was the most important factor, and said that those who were trying to produce very low total carbon iron were meeting with almost the same troubles as were met with in the steel foundry. Growth was not due entirely to total carbon, but also to the splitting up of the pearlite in the casting; the more silicon present the less stable was the pearlite.

A Speaker asked what constituted Perlit iron.

Mr. Young replied that it was described in the patents. With regard to chills, if it were found that they were necessary in Perlit work one could use them just as in ordinary iron work. In some castings, in which he had used 20 or 30 chills previously, he was now able to dispense with them altogether, but naturally, in the example of a propeller, it might be necessary to chill the boss.

Mr. Wesley Lambert (Past Branch-President) asked how, if the mould was heated to a uniform temperature, it was possible to ensure the most desirable conditions of differential cooling of metal in the mould. It seemed to him that in a way the same conditions appertain in this process as do in the orthodox method, namely, that the lighter parts of the casting must necessarily cool more quickly than the heavy parts. Previous to the lecture that evening, he had assumed that the various portions of a mould had to be heated to predetermined temperatures having a relation to the sections of the casting to be founded; in other words, that the portion of the mould related to light sections of a casting would be heated to a higher temperature than those portions related to the heavier sections of the casting. He now understood, from the lesturer's description of the Perlit process, that the temperature of the mould was the same throughout.

Mr. Young replied that at first he also could not conceive how it was possible for a mould at the right temperature and poured with metal of the correct heat and composition to produce such results as were obtained, but he was faced with the fact that it did. His view of it was that the sand, when heated to 400 deg. C. or thereabouts, was a non-conductor of heat, and, when the metal was poured, the surfaces of the mould and the metal attained precisely the same temperature before solidification took place, the whole mass, both thin and thick sections, cooling uniformly.

Mr. Lambert asked Mr. Young if he had put thermo-junctions into the sand adjacent to the thin and thick portions, and had found that the heat conductivity was practically identical, irrespective of whether it was adjacent to the thin or the thick portions. That would be evidence of whether Mr. Young's theory was tenable or not.

Mr. Young said he had put thermo-junctions at distances of 1 in., 1½ in., 2 in., and so on from a casting weighing about 5 tons, and had found that the thermo-junction which was 2 in. away from the metal had not altered in temperature 1½ hours after the casting was poured. It seemed almost unbelievable, and he had repeated it, with the same result. Therefore, he concluded that sand at 400 deg. C. was a non-conductor of heat, and it was only the surface of the mould, which was just touching the heated metal, which was heated up, but insufficiently to form a skull of chilled and adherent metal.

Mr. Gibbs asked if it were not a fact that pearlitic cast iron could be made with 2.3 per cent. of silicon, and was so made by a firm in Germany. Also, he believed it had been stated by Dr. Stead that a certain percentage of silicon did reduce the total percentage of graphite, although he admitted that that was quite opposite to the ordinary routine teaching.

Mr. Young replied that that depended upon thickness. If a thin casting were cast with a high-silicon iron it might have a pearlitic structure, but a thicker casting would not. Any one silicon-content did not produce homogeneous structure and grain in castings of all sections and masses.

Mr. Gibbs said he had seen a photograph in the Press of a casting with unequal thicknesses, made of 2.3 per cent. silicon iron, in which the structure was homogeneous.

Mr. Young replied that photograph was identical with one of the castings he had examined in Germany, and was misleading. The thin section, he saw, was obviously cementitic, and the thick section was of ordinary grey iron, more or less pearlitic.

Vote of Thanks.

Mr. H. G. Sommerfield (Branch-Hon. Secretary) proposed a hearty vote of thanks to Mr. Young for his lecture. Dealing with the financial aspect of the Perlit process, he said that, despite the labour and delay costs which had been referred to, he believed Mr. Young had said a cheaper iron would be produced by the Perlit process than by the ordinary process. If that were so, could the lecturer say what definite tonnage any given foundry would have to produce in order to be square with the cost of its Perlit licence. With regard to pig-iron, he was quite sure, from his experience up and down this country and abroad, that there was a definite insistence on the part of founders upon having the very best pig-iron they could get, and good value for money, and they were not prepared to accept what the pig-iron manufacturers chose to give them.

Mr. J. Ellis (Past President of the Institute) seconded the vote of thanks. Speaking as a practical foundryman, he said he supposed all foundrymen had made Perlit iron many years ago, and it was quite a custom to pour loam and dry-sand moulds hot, but they did not know what they were doing, and that was why such men as Mr. Young and metallurgical chemists were such an acquisition to the Institute and to the industry.

Mr. Young acknowledged the vote of thanks. Referring to Mr. Sommerfield's question as to how much tonnage a foundry would need in order to make the Perlit licence worth while, he said it depended upon the cost of the Perlit licence and the trade the foundry catered for. The point that interested him, however, was the fact that in this country there were a great many foundries with little or no tonnage at all, although there were many orders for Perlit. Perlit had made a name for itself abroad, and would do so here. He fully agreed that pig-iron was worth paying for: a *really* good speciality pig-iron was worth its weight in—good pig-iron. He foresaw many possibilities in the Perlit process. For instance, at present, if chromium were added to cast iron, the iron went white, but with the Perlit process one might be able to make grey iron containing a considerable amount of chromium, and that iron probably would have properties which we were not acquainted with to-day.

The Cupola Furnace.

By J. E. Hurst.

(*Continued from page* 172.)

A modified cupola involving certain novel features and utilising a regenerative system for preheating the blast has been recently devised. This cupola is known as the Schürmann cupola. The air is injected across the melting zone and the products of combustion, instead of being allowed to rise up the cupola stack through the heated coke, are lead into the brick-lined chamber of a regenerator system. By this means it is claimed that the secondary action and reduction of the carbon dioxide is largely eliminated and the conserving of the heat in the regenerator and the utilisation of the hot blast enables rapid and hot melting to be obtained with a considerable increase in efficiency and reduction in coke consumption.

Factors in Cupola Design.

(*a*) *Cross-sectional Area and Melting Rate.*—It is the common practice to relate the rate of melting of a cupola to the cross-sectional area of the cupola. This practice is not strictly correct, and only holds when the other conditions of design of the cupola are strictly proportional. The rate of melting will depend upon the rate of combustion of the fuel and the efficiency of the transmission of the heat from the incandescent fuel and gases to the metal constituting the charge in the cupola. These factors will depend upon the blast pressure, and quantity, the height of the cupola in addition to the cupola area, and in the above relation it is tacitly assumed that these additional conditions are strictly proportional.

With the blast pressures and quantities in common use 1 to 1.1 lbs. of coke are burnt per sq. in. of cross-sectional area at the tuyere level. This is equivalent to 10 to 11 lbs. of metal melted per sq. in. of cupola area per hour at the best practical coke to iron ratio of 1:10. This rule is quite satisfactory for determining the nominal melting rate of cupolas.

With all other conditions constant, it will be seen that the effectiveness of the penetration of the blast to the centre of the cupola is proportional to the diameter rather than the cross-sectional area, and in his experiments F. J. Cook[5] found that the melting rate was more nearly proportional to the diameter. Cook devised a relation for determining what he describes as the maximum rate of successful output. This relation is as follows:—

$$T = \frac{W \times \sqrt{P}}{120} \text{ when } \frac{W \times \sqrt{P}}{D} = 330.$$

where T = output in tons per hour; where W = quantity of air in lbs. per minute; where P = pressure in ozs., and where D = diameter in feet.

These relations give somewhat higher results than the cross-sectional area relationship, and again it is assumed that there is some proportionality between the height and the diameter of the cupola.

(*b*) *Height of Cupola.*—The effective height of the cupola is from the tuyere level to the charging door, and it will be readily seen that this determines the time of contact between the hot gases and the burden. The usual practice adopted in present-day cupola design is that the height from the tuyere level to the charge door level is from 5 to 6 times the diameter of the cupola at the tuyere level.

A recent description of American practice with regard to height is due to Dyer.[6] In small cupolas the height is stipulated to be sufficient to carry 6 to 8 ft. of stock to charging level in small cupolas, 9 to 10 ft. in medium cupolas, 11 to 14 ft. in large cupolas.

(*c*) *Pressure and Quantity of Air Supply.*—The quantity of air at N.T.P. required to burn 1 lb. of coke containing 10 per cent. ash to CO_2 is 137 cub. ft., or 10.40 lbs. Therefore, since 1 lb. of coke is required to melt 10 lbs. of iron, 137 cub. ft. of air are necessary for 10 lbs. of iron, or 30.600 cub. ft. of air per ton. This may be alternatively stated as 137 cub. ft. of free air per sq. in. cupola area at the tuyere level per hour. This is the minimum quantity of air necessary to ensure complete combustion with a coke to iron ratio of 1:10. With less ratios than this more air is necessary to ensure complete combustion of the coke. With coke containing 10 per cent. ash the air required per ton with different coke ratios is given in the table:—

Coke Ratio.	Air per ton at N.T.P.
1 : 10	30,600 cub. ft.
1 : 9	34,150 ,,
1 : 8	38,400 ,,
1 : 7	43,750 ,,
1 : 6	51,000 ,,

In practice it is usual to maintain the coke ratio and the quantity of air required constant. If for any reason the coke ratio requires to be decreased, as is sometimes the case where very hot iron is required, the necessity of providing for an increased air supply is apparent. This can be accomplished where D.C. current is available by the use of a variable speed fan.

Considerable variation in practice is found as regards the pressures used in different cupolas, pressures being used varying from 5 to 16 ozs., or 8½ to 27.5 in. water gauge. It is very desirable to secure conditions in which the air supply penetrates to the centre of the burden in the cupola, and it is considered that the pressure of the air supply is some indication of the successful penetration. In the case of fan blowers the pressure is partially dependent upon the resistance offered to the passage of the air, and does not necessarily indicate the effectiveness of the penetration of the air into the charge. For this reason it is very necessary to have some indication of the velocity of the air supply or the quantity of air per unit time delivered to the cupola.

It is generally recommended that the pressure be increased with increasing diameter of cupola, and the values usually specified are as follows:—

Diameter.	Pressure.	Water gauge.
24 to 36 in.	8 ozs. per sq. in.	13.8 in.
36 to 48 in.	9 ,, ,,	15.5 in.
48 to 60 in.	10 ,, ,,	17.25 in.

The author prefers higher pressures than this, as will be explained in the subsequent section.

The following table of constants are of assistance in calculations relating to cupolas:—

TABLE III.—*Useful Constants for Cupola Practice.*

1 B.T.U.	=	0.252 calories.
1 Calory	=	3.968 B.T.U.'s.
1 lb. air at N.T.P.	=	13.14 cub. ft.
1 cub. ft. air N.T.P. ..	=	0.0761 lbs.
1 lb. pure carbon requires 11.60 lbs. air for combustion to CO_2		
1 oz. per square inch ..	=	1.725 in. water gauge.
1 in. water gauge	=	0.577 ozs. per sq. in.

Tuyere Area.

The general rule for the tuyere area is that this shall be 20 per cent., or ⅕ the cross-sectional area of the cupola at the tuyere level. With the idea of obtaining somewhat higher pressures with increased diameters of cupolas it is frequently recommended that the tuyere area should be 17.5 per cent. of the cross-sectional area of the cupola for diameters of from 48 in. to 60 in. For smaller diameters from 24 in. to 36 in., 25 per cent., or ¼ of the cross-sectional area at the tuyere level is allowable.

Much smaller areas than these are also recommended. For example, Cook recommends for

[5] "J.B.F.A." 1910.
[6] "Iron Age."

XUM

general work a tuyere area of $\frac{1}{8}$ the cross-sectional area of the melting zone and $\frac{1}{12}$ to $\frac{1}{16}$ the cross-sectional area of the melting zone for cylinder work. This constriction in tuyere area is coincident with an increased blast pressure. Table IV has been constructed showing the nominal capacities and air quantities required for various diameter cupolas. The capacities are based upon a coke ratio of 1:10 parts of iron melted. The total tuyere areas up to 36 in. diameter are 20 per cent. and up to 60 in. diameter 17.5 per cent. of the cross-sectional area of the cupola. The quantity of air per unit tuyere area and the velocity of the air supply are given in the last two columns. The pressures determined from the relation:—

$$V = \sqrt{2g\frac{P}{d}}$$

where V = velocity in feet per sec.; where P = pressure in lbs. per sq. in.; where d = weight of 1 cub. ft. air are given in the last column. With trumpet-shaped or flared tuyeres about 10 per cent. reduction requires to be made for the coefficient of discharge, and additional allowances are required for friction losses in the pipe lines.

Number and Shape of Tuyeres.

It is now generally agreed that there is no special merit in having more than one row of tuyeres, providing the requisite quantity of air is passed through the cupola. There is no doubt that a single row of tuyeres passing the correct amount of air effects a distinct saving in the height of the bed coke required. This has not yet been generally accepted by all founders, and the majority of standard cupolas are fitted with at least two rows of tuyeres.

The type of tuyere in which the air is expanded on entering the cupola is now almost universally adopted, and the tuyeres may be either rectangular or circular in cross-section, expanding towards the cupola to twice the area at the entry. This type of tuyere has a high discharge coefficient as compared with the parallel nozzle, the respective coefficients being 0.92 and 0.50.

The modern tendency in tuyere design is to endeavour to admit the air at all points round the circumference of the tuyere area. The various ways of arranging the tuyeres tangentially to the circumference have almost all been abandoned. The admission of air from the blast main into the wind belt tangentially is a good feature of design, and eliminates the pressure losses due to turbulence of the air in the main.

The Lining and Shape of Lining.

Experience over the past few years has clearly shown that the advantages gained by extensive constriction of the lining of the furnace are not compensated by the disadvantages. It is generally agreed that definitely parallel lines are the best. A slight taper outwards towards the charging door is still very commonly used. By virtue of the slight reduction in the velocity of the gases passing up the stack and thus prolonging their contact with the charge, some slight advantage might be gained from this form. The gain is undoubtedly very small.

Table IV.—*Melting Capacities, Air Quantities and Pressures of Cupolas.*

Diameter of Cupola.	Cross-sectional area. Sq. ins.	Melting capacity.		Quantity of air.		Tuyere area. Sq. ins.	Velocity of air. F.P.S.	Pressure inches W.G.
		Lbs. per hr.	Tons per hr.	Per ton.	Per min.			
				Cub. ft.	Cub. ft.			
15	176.715	1,767	0.80	30,000	500	35.34		
20	314.16	3,141	1.40	52,500	875	62.83		
25	490.875	4,908	2.20	82,500	1,373	98.17		
30	706,860	7,068	3.16	118,000	1,966	141.37		
35	962.115	9,621	4.30	161,500	2,692	192.40		
40	1,256.64	12,566	5.60	210,000	3,500	251.33		
45	1,590.43	15,904	7.10	268,000	4,466	294.15		
50	1,963.50	19,635	8.75	328,000	5,466	362.97		
55	2,375.83	23,758	10.50	393,000	6,560	439.20		
60	2,827.44	28,274	12.50	467,000	7,800	522.81		
65	3,318.31	33,183	14.80	555,000	9,250	613.83		
70	3,848.46	38,484	17.20	645,000	10,750	711.88		
							34 ft. per sec. Approx.	36 in. W.G., less discharge coefficient. Discharge coefficient approx. 10 per cent.
							36 ft. per sec. Approx.	42 in. W.G., less discharge coefficient.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Moulders' Brads.

To the Editor of The Foundry Trade Journal.

Sir,—Your correspondent "Core Gum" draws attention to the price of moulders' brads. Assuming that the prices quoted are for like quantities there certainly is a variation that calls for investigation by buyers.

In the same issue appears a Paper entitled "The Necessity for Standardisation in Modern Foundry Practice," in which foundry requisites are mentioned, and although brads are not named they call for primary treatment.

If your correspondent compares the various gauges of material from which moulders' brads are made, he would still be more amazed. It is no uncommon thing to find 2 in. brads stamped from the same gauge plate as used for making 6 in., and often the 6 in. brads are 30 per cent. heavier than is necessary. Continental foundry brads are only a fraction of the weight of the British article.

Brads are more commonly used in jobbing foundries, and where no attempt is made for recovery, amount to a considerable item in the course of a year.

Back in the last generation it was the major duty of the "latest comer" shop boy to recover brads from the shop "riddlings," and straighten them for use again, but this duty seems to have lapsed, generally—in this age of machines and "hot spots." It may have been a tedious job, but it certainly instilled some idea of economy in all directions.

Yours, etc.,
"Standard."

The Cupola Furnace.

To the Editor of The Foundry Trade Journal.

Sir,—I am surprised that such a careful writer as J. E. Hurst should have quoted such absurd melting temperatures as appeared in his thermal balance sheet. A moment's cool consideration would have made plain, first, that the 1,800 deg. C. should be 1,900 deg. C. for 3,452 deg. F. Secondly, that no cupola lining would stand up to such a temperature. At 100 deg. C. below that figure puro fireclay would run like water. One can only think the figure of 3,452 deg. F. should read 2,452 deg. F. (1,333 deg. C.). Such a figure would be in keeping with ordinary good practice. There are only two investigations of the internal temperatures of cupolas that are worth considering, viz., Bulletin 54 American Bureau of Mines and the one carried out at Sultzer Bros. ("F.T.J.," August 13, 1925). The highest temperature in both cases was never over 1,500 deg. C., and in neither case were the investigators positive, owing to difficulties with the downward movement of the charge. I know Mr. Hurst will be the first to admit the figures he quoted are not correct.—Yours, etc.,

J. Shaw.

Sheffield.

Sterling

These two cross sections stand as a symbol for strength

THEY SHOW THE SHAPE OF THE SPECIAL ROLLED CHANNEL STEEL FROM WHICH ALL STERLING MOULDING BOXES ARE MADE.

And not only for *strength* but also for *durability* and *long life* this Rolled Steel Bar is the ideal material for making Moulding Boxes.

ASK THE OPINION OF ANY STERLING USER

AND HAVE YOUR NEXT LOT OF BOXES MADE IN ROLLED STEEL

STERLING FOUNDRY SPECIALTIES LTD. BEDFORD
LONDON OFFICE, 13, VICTORIA STREET, S.W.1.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.
CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

Established 1872. *Telegraphic Address: "Steel, Glasgow."*

GANISTER, CUPOLA BLOCKS, FIRE BRICKS, FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

Trade Talk.

SIR WILLIAM ARROL & COMPANY, LIMITED, have an order for the reconstruction of the London & North-Eastern Railway bridge at Airdrie, at a cost of nearly £20,000.

MR. J. E. BROWN lectured to the members of the Sheffield File Trade Technical Society, recently, on the subject of "File-cutting Machinery." Mr. P. Schofield presided.

VICKERS, LIMITED, have secured an additional order for the third unit for the Holborough Cement Works, Snodland, Kent, which comprises a kiln, cooler, wash mill and mixer plant.

THE L.N.E.R. HAS PLACED contracts with the Tees-side Bridge & Engineering Works, Limited, Pease & Partners, Limited, and Cochrane & Company, Limited, Middlesbrough, for 4,500 tons of cast-iron chairs.

THE UNION OF SOUTH AFRICAN RAILWAYS have ordered from Beyer, Peacock & Company, Limited, Gorton Foundry, Manchester, ten Garratt patent articulated locomotives, each having a total weight of 136 tons, to be delivered before August.

EARLE'S SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Hull, have an order for a cargo boat for the London & North-Eastern Railway, and A. McMillan & Son, Dumbarton, have orders for four cargo motor-ships for the British & African Steam Navigation Company, Liverpool.

IN CONNECTION with the paragraph which appeared in THE FOUNDRY TRADE JOURNAL of February 25, page 160, regarding the dissolution of partnership of Mr. W. E. Gunthorpe, Mr. C. Forrest, Mr. A. Sym and Mr. R. Sym, trading as Forrest & Sym, iron-founders and engineers, Manchester, we are informed that Mr. W. E. Gunthorpe has severed his connection with the firm and that the business is being carried on as before under the same title by the three remaining partners, Messrs. C. Forrest, A. Sym and R. Sym.

THE BRITISH EVERTITE LOCKNUTS, LIMITED, St Margaret's House, 57 & 59, Victoria Street, Westminster, S.W.1, have been registered with an authorised capital of £30,000, for the purpose of placing on the market the "Evertite" locknut. Externally the "Evertite" closely resembles an ordinary nut, but it has a bevelled end and an annular groove (V-cut) within the nut. When screwed home with the bevelled end in contact with the resisting surface, the reaction causes the groove to yield. A slight but sufficient distortion of the thread then results, thereby effecting a positive (or direct) lock upon the bolt, and functions repeatedly without injury to the thread of either nut or bolt.

A RESOLUTION PROTESTING against the grant made to the Appleby Iron Company, Limited, by the Trade Facilities Act Committee, for the completion of their steel plate mills, was passed by the Tees Conservancy Commissioners, at their meeting at Middlesbrough last week, on the ground that there were already an excessive number of plate mills, which could not find sufficient work, and any additions at present would have a detrimental effect on the Tees-side district. Mr. Benjamin Talbot declared that there was more than sufficient productive capacity in the country to-day to meet requirements, and any probable increase for many years to come. A similar resolution has been passed by the West Hartlepool authorities.

THE BUSINESS of J. Hopkinson & Company, Limited, Huddersfield, has been converted into a public company. The new company, the title of which is Hopkinsons, Limited, will have a capital of £700,000, divided into £350,000 seven per cent. cumulative preference shares and £350,000 ordinary shares. The latter have been placed under a contract made with B.S.T., Limited, at 25s. per share, 131,000 shares out of the 350,000 being reserved for the directors and employees of the company. The whole of the preference shares were offered to the public at par last Monday. The prospectus will show profits for a period of 3½ years; during this time there has been very little variation in the total, and the average works out at £100,000.

INTERNATIONAL COMBUSTION, LIMITED, propose to proceed immediately with an extension of the works at Derby. A new foundry section for heavy castings, with core-drying ovens, pattern shops and storage, cupolas and complete range of modern handling equipment is to be started at once. The extensions also include an entirely new machine shop, office extensions and a new shop for the fabricating of sheet-metal work, bunkers, cyclones, etc. Provision has also been made for extending the transport system, loading and despatch berths to the new buildings, and the total value of the work is estimated at about £100,000. At the Barrow works additional machinery is to be installed immediately for dealing with the manufacture of Raymond pulverisers.

Personal.

MR. J. H. LLOYD, of Stewarts & Lloyds, Limited, is paying a visit to South Africa.

MR. D. W. HEATH has been elected a director of Samuel Heath & Sons, Limited.

MR. W. S. JARRATT has been appointed Comptroller-General of Patents, Designs, and Trade Marks in succession to Mr. W. Temple Franks, who has retired on account of ill-health. Mr. Jarratt has been one of the Assistant Comptrollers at the Patent Office since 1921.

MR. H. J. MAYBERY has resigned his position with the British Aluminium Company, Limited, Kinlochleven, to join the metallurgical staff of J. Stone & Company, Limited, engineers and founders, Deptford. Mr. Maybery, who was formerly metallurgist to the Magnesium Company, will devote his attention to research work on the light alloys of aluminium and of magnesium. The foundries and metallurgical department of J. Stone & Company's works at Deptford and Charlton, are under the direct supervision of Mr Wesley Lambert, member of council and past-president of the London Branch of the Institute of British Foundrymen.

Wills.

DOAR, A. C., lately secretary of the Stanton Iron Works Company, Limited	£69,418
EMETT, C., of Chesterfield Road, Ashley Hill, Bristol, metal merchant	£27,249
KING, R., of David King & Sons, Limited, Keppoch Iron Works, Possilpark	£25,674

Contracts Open.

Coventry, March 15.—Castings, for 12 months ending March 31, 1927, for the General Works Committee. Mr. E. H. Ford, city engineer and surveyor, Council House, Coventry.

Dundee, March 24.—Iron and steel, etc., during year from date of acceptance to May 15, 1927, for the Tramway Committee. Mr. W. T. Young, general manager, Tramway Office, Dundee.

Great Yarmouth, March 19.—Iron and steel, etc., for twelve months from April 1, 1926, to March 31, 1927, for the Town Council. The Borough Engineer's Office, Great Yarmouth.

Johannesburg, April 1.—Wheels, for the South African Railways and Harbours. The Department of Overseas Trade (Room 50), 35, Old Queen Street, London, S.W.1. (Ref. A.X. 2870.)

London, S.E., March 12-18-19.—Pig-iron, etc., for the Director-General, India Stores Department, Branch No. 14, Belvedere Road, Lambeth, London, S.E.1.

London, S.E., March 23.—Steel framework, for the Director-General, India Store Department, Branch No. 14, Belvedere Road, Lambeth, London, S.E.1. (Fee, 5s., non-returnable.)

Lydney, March 15.—Main, for the Lydney Rural District Council. A. P. I. Cotterell & Son, chartered civil engineers, 17, Old Queen Street, Westminster, or Mr. G. J. Elliott, surveyor to the Lydney Rural District Council, Highland Villa, Lydney. (Fee, £3 3s., returnable.)

Mapperley, March 20.—Cast-iron mains, for the Belper Rural District Council. Elliott & Brown, chartered civil engineers, Burton Buildings, Parliament Street, Nottingham. (Fee, £1 1s., returnable.)

Walberswick, March 17.—Main, etc., for the Blything Rural District Council. Mr. J. W. Yallop, clerk, Bulcamp, Halesworth, Suffolk. (Fee, £5 5s., returnable.)

Whitstable, March 15.—Water mains, for the Urban District Council. Mr. J. Dunn, surveyor and water engineer, Council Offices, Whitstable. (Fee, £2 2s., returnable.)

THE IRON AND STEEL TRADES CONFEDERATION has decided to affiliate with the Industrial Alliance.

THE 48TH ANNUAL MEETING of the Institute of Chemistry was held last week, Professor G. G. Henderson in the chair. The Meldola Medal was presented to Dr. Henry Phillips. The annual report showed that the roll of the institute now numbered nearly 5,000 Fellows and Associates. The president referred to the decrease in unemployment in the profession, and mentioned that there were indications that not only those industries which were strictly chemical in character but many others were finding that well-trained research and analytical chemists were necessary to combat the effects of industrial depression. The question of seeking statutory powers of registration for professional, consulting, and analytical chemists was under consideration.

TRUTH IN ADVERTISING

We give below the opinion of a firm who are regular users of our ganister.

> *"In reply to your favour of the 29th ult., we have pleasure in informing you that for a great number of years we had been casting around for a suitable ganister without success, until we were recommended to you. Since then your ganister has given entire satisfaction and we always have pleasure in recommending it to our numerous friends."*

Manufactured from Sheffield Rock Ganister and sold at a low price, our Ground Ganister is rapidly becoming recognised as

THE GANISTER SUPREME

Its consistent high quality is due to its ingredients; its low price is due to bulk production.

LET US REDUCE YOUR COSTS

WEBSTER & CO. (SHEFFIELD) LTD.
FOSTER'S BUILDINGS, SHEFFIELD.

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—Recent activity in the Cleveland iron trade has been considerably modified of late, and at the moment is replaced by very quiet conditions, with business in all departments reduced to quite moderate dimensions, buyers evidencing a disposition to hold off the market with a view to probable price concession in the near future. This expectation is based upon the assumption that fuel costs having been recently reduced, prices of pig-iron should naturally incline in a similar direction. At last week's market, however, smelters made no move indicating this intention, and while home demand is still sufficient to absorb current production, it may be regarded as doubtful whether any immediate price changes can be contemplated by Tees-side makers. As regards overseas movements, the feature of the February shipments of pig-iron from the Tees is the low figure to which exports abroad have fallen, the total being only 14,680 tons, or some 4,000 tons below January. With the coastwise shipments of 19,586 tons, the aggregate reached 34,266 tons, as compared with 36,019 tons in January. Meanwhile, export quotations remain as follow, with home prices 6d. per ton less:—No. 1, 73s.; No. 3 G.M.B., 70s. 6d.; No. 4 foundry, 69s. 6d.; and No. 4 forge, 68s. 6d. per ton.

Home demand for Tees-side hematite continues fairly steady, but unfortunately Continental inquiry has fallen away considerably, and the amount of business passing at the moment is very moderate indeed. Sellers, however, are reluctant to effect any further commissions, and the quotation for East Coast mixed numbers is unchanged at 77s. 6d., the No. 1 quality being 78s. per ton. On the North-West Coast prices are firm, with Bessemer mixed numbers £4 2s. 6d., c.i.f. Welsh ports; £4 5s. 6d. to £4 7s. 6d. per ton delivered at Glasgow; £4 10s. per ton delivered at Sheffield; and £4 14s. 6d. per ton delivered at Birmingham.

LANCASHIRE.—The local markets for foundry pig continue inactive, although makers keep fairly busy on orders secured some time ago, but new business is anything but satisfactory, most users showing little disposition to enter into further forward contracts. Makers are firm in their ideas of selling prices, and for delivery in the Manchester area or equal distance Derbyshire No. 3 is steady at 76s., with Staffordshire and Lincolnshire brands also at about the same figure. Scottish iron comes in at about 94s. per ton, delivered.

THE MIDLANDS.—As intimated in previous reports of conditions in the foundry-pig markets in this area the volume of orders in circulation is on a diminished scale, as compared with recent transactions, and although some furnaces are well sold forward, others are by no means in a satisfactory position as regards outlook. Ruling quotations are as follow:—Derbyshire No. 3 foundry, 67s. 6d. to 68s. 6d.; Staffordshire No. 3 foundry, 67s. 6d. to 68s. 6d.; Northants, No. 3 foundry, 64s. to 65s.

SCOTLAND.—Conditions in the Scottish pig-iron markets are unchanged, business being confined to small quantities, while the threatened trouble with the engineers is a retarding factor. Meantime, traders generally are adopting a policy of simply marking time, and prices are unchanged on the basis of 76s. 6d. for No. 3 foundry, f.o.t. furnaces.

Finished Iron.

Scarcely any improvement can be noted in this section of the trade, both mills and forges producing finished material being mostly much in need of fresh specifications. In the Black Country makers report a quiet demand with crown quality iron bars offered at £11 per ton the cheapest, up to £11 10s. per ton, but business is very difficult to obtain, and just now there is a considerable amount of competition between the Derbyshire, Lancashire and Staffs. houses for the limited tonnage being placed. Nut and bolt iron from local mills is quoted at £10 5s and £10 7s. 6d. per ton, delivered, but bulk tonnage is absent, as supplies are now coming through more regularly against old contracts with the Belgian works. As has been previously reported, the bulk of the business must of necessity go to the Continental works while present conditions obtain, as it is quite impossible for the English makers of this cheap iron to come anywhere near the present quotations from the foreign mills. There is still a fair demand for iron tube strip, and the makers of this material are quite moderately engaged, the basis quotation being £12 10s. per ton. Marked bars are unchanged at £14 per ton at makers' works, but business is not developing in the way the makers anticipated, and they have a very meagre order book at this juncture.

Scrap.

Movements in the various markets for this class of material may be best described as spasmodic, with demand, in most instances, only on a moderate scale. In Lancashire inquiry is slow, with machinery cast-iron scrap quoted at 70s. to 72s. 6d. per ton for ordinary kinds, and about 5s. higher than these figures for textile machinery scrap, delivered. In Scotland, with the slight improvement in shipbuilding, due to the recent orders placed on the Clyde, steel and iron works now show more interest in the covering of their requirements in scrap material, and more business in general has been recently noted. Heavy machinery cast-iron scrap is still quoted around 74s. to 75s. per ton, with ordinary cast-iron scrap suitable for foundries at 68s. to 70s. per ton, and old cast-iron railway chairs at 73s. to 75s. per ton. Light cast-iron and firebars are at 61s. 6d. to 62s. 6d. per ton. The above prices are all per ton, delivered f.o.t. consumers' works.

Metals.

Copper.—The persistent decline in values of standard copper, as reported of late, has been maintained with scarcely any interruption, fluctuations being daily, mainly in the direction of lower levels. The price of warrant copper is still low as compared with electrolytic, the margin between the two being about £2 a ton more than it ought to be, at the expense of standard metal. This will sooner or later be corrected or removed by the taking up of further considerable quantities of rough bar copper from home warehouses for shipment to the United States. Current quotations:—*Cash*: Thursday, £58 15s.; Friday, £59 2s. 6d.; Monday, £59; Tuesday, £59; Wednesday, £59.

Three Months: Thursday, £59 15s.; Friday, £60; Monday, £60; Tuesday, £60; Wednesday, £60.

Tin.—The tone of the tin market is fully maintained at recent strength, with values still advancing. Present prices are higher than at any time since 1924. The extremes that year were £298 and just over £200, while in 1925 the range was from £290 down to £229, the end of the year seeing the metal very near its best. At the end of January the total visible supplies were estimated at 15,600 tons, and the figures for end-February are just 15,100 tons, the lowest total for years past. Current quotations:—*Cash*: Thursday, £292 5s.; Friday, £293 5s.; Monday, £292 10s.; Tuesday, £292 7s. 6d.; Wednesday, £293 10s.

Three Months: Thursday, £282 5s.; Friday, £283 17s. 6d.; Monday, £282 5s.; Tuesday, £282 15s.; Wednesday £284 5s.

Spelter.—Movements in this section of the market mostly disclose a lower tendency of values, while business is by no means on a heavy scale. With plenty of metal coming forward from the Continent last week, the price for prompt delivery dropped into a small discount, but there ensued some improvement from the lowest, while current prices are more reasonable, and home consumption continues on a fairly heavy scale. Current quotations:—*Ordinary*: Thursday, £34 18s. 9d.; Friday, £35 1s. 3d.; Monday, £35; Tuesday, £34 11s. 3d.; Wednesday, £34 10s.

Lead.—In the market for soft foreign pig the decline in consumptive demand has induced reserve on the part of buyers, with values again below recent levels. There was, however, a rally from the worst lately, and the market thus shows resistance, although confidence is lacking, and there is a possibility of another setback. The situation at Broken Hill appears to have failed to impress consumers. Current quotations:—*Soft foreign (prompt)*: Thursday, £32; Friday, £32 5s.; Monday, £32 2s. 6d.; Tuesday, £31 12s. 6d.; Wednesday, £31 12s. 6d.

ERITH LOAM
J. PARISH & CO.,
ERITH.

FOUNDRY REQUISITES.
Try our REFRACTORIES.
Ganister or Silica Bricks and Blocks (any shape or size).
Sands, Cements, Ganister.—*Let us have your enquiries.*
THE CLEVELAND MAGNESITE & REFRACTORY CO., LTD.,
Normanby Brickworks, Normanby, Eston, Yorks.

OEHM'S

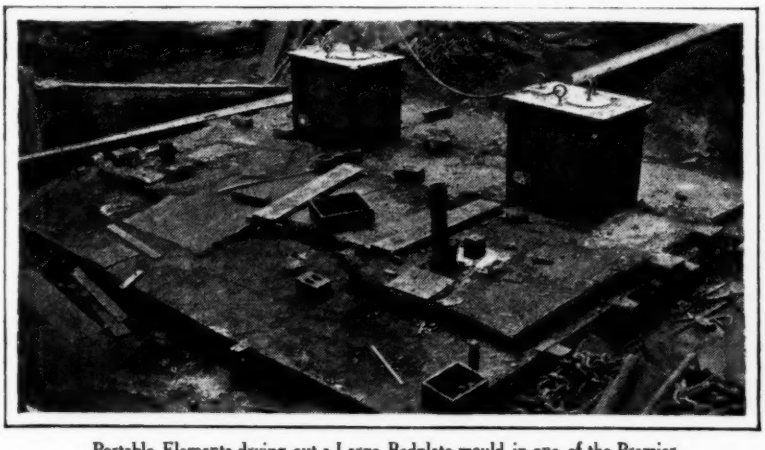
PATENT

HEATING ELEMENTS

(ENTIRELY BRITISH MADE.)

HALVE YOUR FUEL BILL

The application of Oehm's Patent Heating Element results in a 50% saving in fuel consumption, and the cheapest form of fuel—hard coke, breeze and even refuse—can be used. It works twice as quickly as any other method and its use in mould drying results in a BETTER CASTING.



Portable Elements drying out a Large Bedplate mould in one of the Premier Foundries in this country.

The OEHM'S Patent Heating Element is the simplest and the most efficient apparatus yet devised for producing high temperatures by the conversion of solid fuel to CO_2 gas, possessing pressure and velocity without flame and without smoke.

For Core and Mould drying on the floor, in Pit or Drying Rooms. For Heating Ladles, Shanks, Ingots, etc. For Annealing and all Heat Treatments.

Write for illustrated booklet.

CONSTRUCTED BY

BRITISH DRYING & HEATING Co., Ltd.,

433, ABBEY HOUSE, VICTORIA STREET, LONDON, S.W.1

Telephone: Victoria 2693. *Telegrams: "Britdriet, Sowest, London."*

BRITISH D&H COMPANY LTD

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash ..	59	0	0
Three months ..	60	0	0
Electrolytic	66	0	0
Tough	62	0	0
Best selected ..	62	10	0
Sheets	90	0	0
India	75	0	0
Wire bars	66	5	0
Do. March	66	0	0
Do. April	66	0	0
Ingot bars	66	0	0
H.C. wire rods ..	70	10	0
Off. av. cash, Feb.	59	14	7⅝
Do., 3 mths. Feb.	60	14	8¼
Do., Sttlmnt, Feb.	59	14	1½
Do., Electro, Feb.	66	12	6
Do., B.S., Feb. ..	64	0	0
Aver. spot price copper, Feb. ..	59	14	1½
Do., wire bars, Feb.	66	17	6
Solid drawn tubes			13d.
Brazed tubes ..			13d.
Wire			10d.

BRASS.

Solid drawn tubes ..	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld. ..	7½d.
Sheets to 10 w.g ..	10½d.
Wire	10½d.
Rolled metal	9½d.
Yellow metal rods ..	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets ..	8½d.

TIN.

	£	s.	d.
Standard cash ..	293	10	0
Three months ..	284	5	0
English	291	15	0
Bars	293	0	0
Straits	292	15	0
Australian	293	5	0
Eastern	284	15	0
Banca	292	15	0
Off.aver. cash, Feb.	287	4	9
Do., 3 mths., Feb.	280	4	4½
Do., Sttlmt. Feb.	287	3	6
Aver. spot., Feb.	287	3	6

SPELTER.

	£	s.	d.
Ordinary	34	10	0
Remelted	34	5	0
Hard	29	0	0
Electro 99.9 ..	37	15	0
English	35	5	0
India	31	0	0
Zinc dust	44	0	0
Zinc ashes	15	0	0
Off. aver., Feb. ..	36	0	1¼
Aver., spot, Feb.	36	1	0¾

LEAD.

	£	s.	d.
Soft foreign ppt.	31	12	6
English	33	0	0
Off. average, Feb.	33	18	0¾
Average spot, Feb.	33	18	0¾

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	43	0	0
Do. V.M. ex whf.	41	0	0
Rods	47	0	0
Boiler plates ..	41	0	0
Battery plates ..	40	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	99	0	0
Chinese	90	0	0
Crude	60	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver ..	14	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon	
25%	9 15 0
45/50%	11 16 0
75%	20 17 6
Ferro-vanadium—	
35/40% 14/– to 15/6 lb. va.	
Ferro-molybdenum—	
70/75% c. free	6/– lb.
Ferro-titanium—	
23/25% carbonless	1/– lb.
Ferro-phosphorus, 20/25%,	£19 0 0
Ferro-tungsten—	
80/85%,c.fr. 1/9½ to 1/11 lb.	
Tungsten metal powder—	
98/99% .. 2/1 to 2/2 lb.	
Ferro-chrome—	
2/4% car. ..	£33 0 0
4/6% car. ..	£22 5 0
6/8% car. ..	£21 15 0
8/10% car. ..	£20 17 6
Ferro-chrome—	
Max. 2% car.	£39 0 0
Max. 1% car.	£45 10 0
Max.0.70%car.	£55 0 0
70%,carbonless1/5½ to1/6lb.	
Nickel—99%, cubes or pellets £172 to £175	
Cobalt metal—98/99% 10/– to 11/– lb.	
Aluminium 98/99% £112	
Metallic Chromium—	
96/98% .. 3/3 lb.	
Ferro-manganese (net)—	
76/80%, loose	£15 7 6
76/80%, packed	£16 7 6
76/80%, export	£15 0 0
Metallic manganese—	
94/96%, carbonless 2/– lb.	
Per ton unless otherwise stated.	

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten ..	2	6
Finished bars, 18% tungsten ..	3	0
Per lb. net, d/d buyers' works.		
Extras—		
Rounds and squares 3 in. and over ..	4d. lb.	
Rounds and squares under ½ in. to ⅛ in. 3d. lb.		
Do. under ⅛in. to 1/16 in.	1/– lb.	
Flats, ½in. × ⅛in. to under 1 in. × ¾ in. 3d. lb.		
Do. under ⅛in. × ⅛in. 1/– lb		
Bevels of approved sizes and sections 6d. lb.		
Bars cut to length 10% extra		
Scrap from high-speed tool steel—		
Scrap pieces	3d.	
Turnings and swarf	1d.	
Per lb. net, d/s steel makers' work		

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Hvy. steel	3	10	0	to 3	12	6
Bundled steel & shrngs.	3	3	6	to 3	7	6
Mixed iron & steel	3	2	6	to 3	5	0
Heavy cast iron	3	3	6	to 3	7	6
Good machinery for foundries	3	7	6	to 3	10	0
Cleveland—						
Heavy steel ..	3	4	0			
Steel turnings ..	2	7	6			
Cast iron borings	2	5	0			
Heavy forge ..	4	5	0			
Bushelled scrap	3	10	0			
Cast-iron scrap	3	5	0			
Lancashire—						
Cast-iron scrap	3	10	to 3	12	6	
Heavy wrought	3	10	0			
Steel turnings ..	2	0	0			
London — Merchants' buying prices delivered yard.						
Copper (clean)..	50	0	0			
Brass (clean) ..	39	0	0			
Lead (less usual draft)	29	0	0			
Tea lead ..	24	0	0			
Zinc	23	0	0			
New aluminium cuttings ..	85	0	0			
Braziery copper	45	0	0			
Gunmetal ..	46	0	0			
Hollow pewter	190	0	0			
Shaped black pewter ..	144	0	0			

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast—	
Foundry No. 1 ..	72/6
Foundry No. 3 ..	70/–
Foundry No. 4 ..	69/–
Forge No. 4	68/–
Hematite No. 1 ..	78/–
Hematite M/Nos. ..	77/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	86/6
,, d/d Birm.	94/6
Midlands—	
Staffs common* ..	—
,, No. 4 forge ..	62/6
,, No. 3 foundry	68/–
Shrops. basic	70/–
,, Cold blast, ord.*	185/–
,, ,, roll iron* ..	190/–
* d/d Birmingham.	
Northants forge	57/6
,, fdry No. 3 ..	64/6
Derbyshire forge ..	62/6
,, fdry. No. 3 ..	68/–
,, basic	65/–
Scotland—	
Foundry No. 1 ..	81/6
,, No. 3 ..	76/6
Hem. M/Nos.	76/6
Sheffield (d/d district)—	
Derby forge	66/6
,, fdry. No. 3 ..	72/–
Lincs. forge	67/6
,, fdry. No. 3 ..	70/–
E.C. hematite	88/–
W.C. hematite ..	90/–
Lincs. (at furnaces)—	
Forge No. 4	61/6
Foundry No. 3.. ..	64/–
Basic	64/–
Lancashire (d/d eq. Man.)—	
Derby forge	70/–
,, fdry. No. 2 ..	76/–
Northants foundry No. 3	77/3
Dalzell, No. 3	110/–
Summerlee, No. 3 ..	94/–
Glengarnock, No. 3 ..	94/–
Gartsherrie, No. 3 ..	94/–
Monkland No. 3	94/–
Coltness, No. 3	94/–
Shotts, No. 3	94/–

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars(cr.)	11	0	0	to 12	0	0
Angles		11	10	0		
Tees to 3 united ins.		12	0	0		
Nut and bolt	10	5	0	to 10	7	6
Hoops	14	0	0	to 15	0	0
Marked bars (Staffs.) f.o.t. ..		14	0	0		
Gas strip		12	10	0		
Bolts and nuts .. ¾ in. × 4 in. ..		16	15	0		
Steel—						
Ship plates	7	7	6	to 7	17	6
Boiler plts. ..		11	10	0		
Chequer plts. ..		9	15	0		
Angles	£7	0	0	to 7	5	0
Tees	£8	0	0	to 8	5	0
Joists	£7	0	0	to 7	5	0
Rounds and Squares 3 in. to 5½ ins. ..		8	0	0		
Rounds under 3 in. to ¾ in.		7	15	0		
Flats, over 5 in. wide and up ..		8	10	0		
Flats, 5in. to 1½in.		7	10	0		
Rails, heavy ..		8	0	0		
Fishplates		12	0	0		
Hoops (Staffs.) ..		10	10	0		
Black sheets, 24g.		11	5	0		
Galv. cor. sheets, 24g.		16	2	6		
Galv. fencing wire 8g. plain		14	0	0		
Billets,soft	£6	2	6	to 6	5	0
Billets, hard ..		8	2	6		
Sheet bars	6	0	0	to 6	2	6
Tin bars d/d	6	2	6	to 6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	3½
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks ..	9d. to 1/5½
Ingots rolled to spoon size ..	1/– to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	23.76
No. 2 foundry, Valley	22.26
No. 2 foundry, Birm.	22.00
Basic	21.76
Bessemer	22.76
Malleable	22.26
Grey forge	21.76
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.80
Beams, etc.	1.90
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 28..	3.25
Sheets, galv., No. 28 ..	4.50
Sheets, blue an'l'd, 9 & 10	2.50
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry ..	32/6 to 37/6
,, furnace ..	20/– to 25/–
Durham & North.	
,, foundry	30/– to 33/–
,, furnace	15/– to 15/6
Other Districts, foundry	30/– to 33/–
,, ,, furnace (basis)	11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	19/4½
,,	28×20, ,,	38/9
,,	20×10, ,,	29/1½
,,	18¾×14, ,,	20/4½
C.W.	20×14, ,,	17/7½
,,	28×20, ,,	35/3
,,	20×10, ,,	24/4½
,,	18¾×14, ,,	18/4½

Terneplates 28×20, 35/9 per box basis f.o.b.

SWEDISH IRON.

Bars,hammered	£18/10 to £19/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12
Pig-iron	£6 15 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes	*Fittings*
Gas	60%	50%
Water	55%	45%
Steam	50%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

		£	s.	d.		
Mar.	4	58	15	0	inc.	7/6
,,	5	59	2	6	,,	7/6
,,	8	59	0	0	dec.	2/6
,,	9	59	0	0	No change	
,,	10	59	0	0	,, ,,	

Electrolytic Copper.

		£	s.	d.		
Mar.	4	65	10	0	inc.	5/-
,,	5	65	15	0	,,	5/-
,,	8	66	0	0	,,	5/-
,,	9	66	0	0	No change	
,,	10	66	0	0	,, ,,	

Standard Tin (Cash).

		£	s.	d.		
Mar.	4	292	5	0	dec.	47/6
,,	5	293	5	0	inc.	20/-
,,	8	292	10	0	dec.	15/-
,,	9	292	7	6	,,	2/6
,,	10	293	10	0	inc.	22/6

Tin (English ingots).

		£	s.	d.		
Mar.	4	291	0	0	dec.	50/-
,,	5	292	0	0	inc	20/-
,,	8	291	0	0	dec.	20/-
,,	9	291	0	0	No change	
,,	10	291	15	0	inc.	15/-

Zinc Sheets (English).

		£	s.	d.		
Mar.	4	43	0	0	dec.	20/-
,,	5	43	0	0	No change	
,,	8	43	0	0	,,	,,
,,	9	43	0	0	,,	,,
,,	10	43	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Mar.	4	34	18	9	inc.	3/9
,,	5	35	1	3	,,	2/6
,,	8	35	0	0	dec.	1/3
,,	9	34	11	3	,,	8/9
,,	10	34	10	0	,,	1/3

Lead (English).

		£	s.	d.		
Mar.	4	33	10	0	No change	
,,	5	33	15	0	inc.	5/-
,,	8	33	10	0	dec.	5/-
,,	9	33	0	0	,,	10/-
,,	10	33	0	0	No change	

AVERAGE MONTHLY PRICES OF UNMARKED BARS (SOUTH STAFFS).

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1897	6 0 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 0 0	6 0 0	6 3 9
1898	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 5 0	6 5 0	6 5 0	6 10 0	6 10 0	6 2 11
1899	6 10 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 10 0	7 10 0	8 10 0	9 0 0	9 0 0	9 10 0	7 12 11
1900	10 0 0	10 10 0	10 10 0	10 10 0	10 15 0	10 15 0	10 5 0	10 5 0	10 5 0	9 10 0	8 15 0	8 15 0	10 1 3
1901	8 0 0	7 10 0	7 5 0	7 0 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 15 0	6 17 11
1902	7 0 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 15 0	6 15 0	6 15 0	6 10 0	6 10 0	6 13 4
1903	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10. 0	6 10 0	6 7 0	6 5 0	6 9 4
1904	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 5 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 0 0	6 2 11
1905	6 5 0	6 5 0	6 0 0	5 17 6	5 15 0	5 15 0	5 15 0	5 15 0	6 0 0	6 5 0	6 15 0	6 15 0	6 1 10½
1906	7 0 0	7 5 0	7 5 0	7 5 0	6 17 6	6 15 0	6 12 6	6 10 0	6 10 0	6 12 6	6 16 3	7 3 9	6 17 8½
1907	7 3 9	7 5 0	7 5 0	7 5 0	7 5 0	7 7 6	7 5 0	7 7 6	7 7 6	7 7 6	7 7 6	7 5 0	7 5 11
1908	7 2 6	7 0 0	7 0 0	7 0 0	6 15 0	6 7 6	6 5 0	6 2 6	6 2 6	6 2 6	6 2 6	6 0 0	6 10 0
1909	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 0 0	6 0 0	5 17 6	6 0 0	6 2 6	6 2 6	5 17 6	5 19 9½
1910	6 2 6	6 3 4½	6 7 6	6 7 6	6 7 6	6 7 6	6 6 6	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 7
1911	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 5 0	6 10 0	6 12 6	6 16 6	6 7 0
1912	6 18 9	7 1 10	7 2 6	7 8 9	7 18 0	8 0 7	8 2 6	8 3 6	8 5 0	8 6 3	8 7 6	8 8 9	7 17 0
1913	8 11 6	8 10 7½	8 10 0	8 8 1½	8 2 0	8 0 0	7 17 6	7 11 6	7 8 9	7 5 6	6 18 1½	6 17 6	7 16 9
1914	6 17 6	6 15 7½	6 12 6	6 10 0	6 10 0	6 10 0	7 10 0	7 11 10½	8 0 0	7 12 6	7 5 7½	7 6 3	7 1 0
1915	7 11 6	8 5 11	8 8 9	9 6 0	10 3 2	10 19 2	11 12 6	11 13 1½	11 13 9	11 14 3	12 1 10½	13 0 9	10 6 0
1916	13 7 6	13 10 8	13 12 9½	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 3 9½
1917	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0	13 15 0
1918	13 15 0	13 17 3	13 17 6	13 17 6	13 17 6	13 17 6	13 17 6	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 4 5½
1919	15 10 0	16 5 0	17 15 0	17 15 0	20 15 0	21 0 0	21 0 0	22 0 0	22 0 0	22 0 0	22 7 6	22 12 6	20 1 8
1920	24 7 6	24 10 0	25 10 0	27 10 0	29 5 0	31 0 0	31 10 0	31 10 0	31 10 0	31 10 0	31 10 0	29 7 6	29 1 8
1921	26 17 3	25 0 0	23 0 0	21 0 0	19 0 0	18 5 0	16 0 0	16 0 0	15 14 0	14 0 0	13 6 8	13 0 0	19 4 5
1922	13 0 0	12 3 9	11 14 0	11 11 10½	11 5 0	11 3 6	11 2 6	11 5 0	10 17 2½	10 16 3	10 13 0	10 12 6	11 7 0½
1923	10 16 10½	11 3 1½	12 2 6	12 8 9	12 11 6	12 1 3	11 15 11¼	11 15 0	11 15 0	11 15 0	12 13 6	12 8 3	11 18 10½
1924	12 9 6	12 10 0	12 10 0	12 15 7½	12 17 6	12 17 6	12 17 6	12 17 6	12 17 6	12 14 0¾	12 12 6	12 12 6	12 14 3½
1925	12 12 6	12 12 6	12 12 6	12 12 6	12 12 6	12 7 6	12 7 6	12 7 6½	12 4 6	11 18 6	11 13 9½	11 13 0	12 6 2¾
1926	11 7 9½	11 5 0	—	—	—	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

18, BENNETTS HILL, BIRMINGHAM.
11, OLD HALL STREET, LIVERPOOL.
EXCHANGE BLDGS., PORT TALBOT.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
ANGAPPA NAICK STREET, MADRAS.

REGISTERED TRADE MARK

1, HONG KONG ROAD, SHANGHAI.
OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR
5, SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.
P.O. BOX 1580, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE

WILLIAM JACKS & COMPANY,

93, HOPE STREET, GLASGOW.

ROYAL EXCHANGE, MIDDLESBROUGH.

SITUATIONS VACANT AND WANTED.

ADVERTISER desires position as Representative for Foundry or Foundry Engineers; has had 15 years' experience of pattern-making and is thoroughly well versed in the latest methods of machine moulding and production, well educated, good appearance, keen worker; excellent references; would value an opportunity; moderate salary.—Box 656, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRYMAN, having first-class experience in Ironfounding, and 5 years in business for self, desires position as Foreman or Manager; knows what to expect from a foundry of to-day; able to build up business, and prepared to accept position in England or abroad; age 32; I.B.F. man.—Apply, Box 638, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOUNDRY FOREMAN, 15 years' control, experience in shop management, general high-class ferrous and non-ferrous castings, working knowledge metallurgy, drawing and patterns, modern machines and commercial side; able to lay out and organise new or develop old foundry; seeks employment in any capacity where these qualifications are valuable.—Apply, Box 652, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

REPRESENTATIVE wanted by old-established Firm of Core Oil Manufacturers; salary and commission.—Box 648, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOREMAN MOULDER wanted for Iron Foundry dealing with medium and heavy castings; must be a practical moulder and able to fix piece-work rates.—Write, stating age, fullest details of experience and wage required, Box 650, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

VACANCY for Partner in well-established Pattern-making Business; well situated and with excellent prospects.—Box 642, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MACHINERY

ELECTRIC FURNACE for disposal, 50 cwts. capacity, complete with Transformers and full equipment; condition as new.—Further details on application to Box 646, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

CUPOLA, Lloyd's Fan, Moulding Boxes, Evans' Ladles with Shanks, Minister of Transport Direction Post, Patterns with Moulding Boxes, Morgan Crucibles, Carriers, Tongs, Wire Brushes, Riddles, Ganister, Rammers, Plumbago, etc., etc.—FISHER & SWAIN, Victoria Foundry, Yeovil.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

MACHINERY, PLANT, &c

HORIZONTAL STEAM-DRIVEN AIR COMPRESSOR, 14-in. steam cyl., 14-in. air, 16-in. stroke, by American Well Works Company.

SENTINEL AIR COMPRESSOR, 260 cub. ft. capacity at 100 lbs. pressure, driven by 55-h.p. motor, 500 volts.

HORIZONTAL BELT-DRIVEN AIR COMPRESSOR, 15-in. cyl., 11-in. stroke, 448 cub. ft. capacity at 70 lbs., by Robey.

BELT-DRIVEN SINGLE STAGE QUADRUPLEX AIR COMPRESSORS, by Reavell, capacity 330 cub. ft. at 80/100 lbs. pressure.

Two very good dishended LANCASHIRE BOILERS, by Thompson, 30 ft. x 8 ft., reinsure for 140 lbs. per sq. in. working pressure; ready for despatch.

FIVE LOCO. TYPE BOILERS, 11 ft. 6 in. long, barrel 2 ft. 8 in. diam., reinsure 170 lbs. pressure.

CATALOGUE (10,000 LOTS) ON APPLICATION.

THOS W. WARD, LTD.,

ALBION WORKS, SHEFFIELD.

FOUNDRY AND STEEL WORKS PLANT.

One to two ton CUPOLA, 18-in. dia., 18-ft. high, with belt-driven Blower, charging Platform, bottom doors, etc.

One 1-ton geared TIPPING LADLE.

Two 15-ton STEEL CRANE TIPPING LADLES.

One 6-ton STEEL CRANE TIPPING LADLE.

WALL RADIAL SWING GRINDERS.

LOAM MILL and MIXER, 4-ft. dia., underdriven.

For further particulars and price write Box 654, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MACHINERY.—*Continued.*

"OLIVER" No. 75 Mechanical Pattern Maker and Universal Wood Milling Machine, with ball bearings; had little use; equal to new; full set tools, accessories, etc.; very low price; photo, full particulars.—FRED BROWN & SON, LIMITED, North Road Works, St. Helens.

PATENTS.

THE Proprietor of the Patent No. 163,543 for Improvements in Rotary Furnaces is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to HASELTINE LAKE & COMPANY, Chartered Patent Agents, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

MISCELLANEOUS.

LETTERS AND FIGURES for Patterns; all sizes; Aluminium; die cast, with pins in one piece; no shellac needed; simply drive them in and they cannot come off. Send for samples and prices.—A. LAKIN & SON, Totley Rise, Sheffield.

FOR SALE, quantity CAST-IRON FURNACE or BENDING BLOCKS, practically new, three sizes, viz., 4½ ft. square, 4½ in. thick, 2 in. square holes; 6 ft. square, 6 in. thick, 1¾ in. square holes; 6 ft. by 4 ft. 5 in. thick, 1¼ in. square holes; price 4s. 3d. per cwt. for selection, f.o.r. Sunderland. Offers made for Works and Plant, any size, for dismantlement.—Apply, WIGHT & COMPANY, LIMITED, Metal Merchants, Sunderland.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. Phone 264.

DURHAM FOUNDRY COKE.—For first-class melting Cokes and keenest prices send your inquiries to LAWSON, WALTON & COMPANY, LIMITED, Newcastle/Tyne.

FOUNDRY BRUSHES, all kinds; Steel Wire Brushes, Tube Brushes, and Boiler Scale Brushes.—WILLIAM OLSEN, LIMITED, Cogan Street, Hull.

BOILER SCALE PREVENTATIVE.—"Zinco-Graphite," our speciality.—Price list and samples from WILLIAM OLSEN, LIMITED, Cogan Street, Hull.

TINPLATE CUTTINGS.—Buyers are requested to send their best price for bright new tin cuttings to "T. P. C.," c/o E. M. HARVEY, 8, Broad Court Chambers, Bow Street, W.C.2.

SUPERIOR SILICA BRICKS

FINE SILICA CEMENT.

TRADE MARK—R. DINAS.

H. & H. E. SMART, KIDWELLY.

66" **CUPOLA,** by THWAITES, drop bottom, been little used; 10 tons per hour at BLACKBURN **£150**

54" **CUPOLA,** by THWAITES, 6 tons per hour, drop bottom, spark arrester, all pipes and valves, just as new, been very little used, a bargain at SLOUGH ... **£100**

48" **CUPOLA,** by THWAITES, as above, but no spark arrester at BLACKBURN **£90**

30" **CUPOLETTE,** by CONSTRUCTIONAL CO., with pipes and fan complete... ... ... **£32**

NEW LADLES—CHEAP.

12 Ton EVANS	£95
5 Ton McNEIL	£38
3 Ton THWAITES	£32
2½ Ton by GEORGE GREEN	£30
2 Ton THWAITES	£26

BUY FROM ME AND SAVE MONEY.

ALEX. HAMMOND. *FOUNDRY MACHINERY MERCHANT,*

14, AUSTRALIA ROAD, SLOUGH.